

**Final Sampling and Analysis Work Plan
Final Residential Surface Investigation
Revision No. 03**

Revised to add Remedial Activities

**Phase III Field Investigation
Vasquez Boulevard and I-70 Site
Denver, Colorado**

Prepared for:



**U.S. Army Corps of Engineers
Omaha District Rapid Response
Building 525 Castle Hall
Offutt AFB, NE 68113**

Prepared by:

**Shaw Environmental & Infrastructure (a CB&I Company)
16406 US Route 224 East
Findlay, OH 45840**

**Contract No. W9128F-12-D0003
Task Order No. 002
Interagency Agreement DW96953911**

July 2013

Final Sampling and Analysis Work Plan Final Residential Surface Investigation

Revision No. 03

Revised to add Remedial Activities

Contract No. W9128F-12-D0003

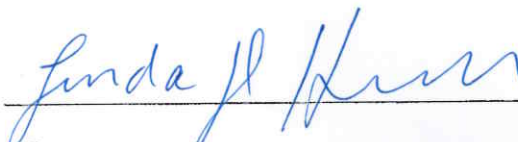
Task Order No. 002

Interagency Agreement DW96953911

July 2013

Reviewed/approved by:

Linda Himmelbauer
EPA Region 8
QA Manager



7/26/13

Paula Schmittiel
EPA Project Manager



7/24/13

Mary Darling
USACE Project Manager

DARLING.MARY.N.123135971

Digitally signed by DARLING.MARY.N.1231359717
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA,
cn=DARLING.MARY.N.1231359717
Date: 2013.07.23 18:31:32 -05'00'

Molly Maxwell
USACE Project
Chemist/QA Manager

GROENJES.CHERY
L.A.1231204756

Digitally signed by
GROENJES.CHERY.L.A.1231204756
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI,
ou=USA, cn=GROENJES.CHERY.L.A.1231204756
Date: 2013.07.24 09:19:18 -05'00'

Morey Engle
Shaw Project Manager



7/23/2013

Guy Gallelo, Jr.
Shaw QA Manager



7/25/2013

Signature

Date

PART 1 – FIELD SAMPLING PLAN

Table of Contents

PREFACE.....	1
1.0 PROJECT BACKGROUND	2
2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES	2
3.0 PROJECT SCOPE AND OBJECTIVES.....	2
4.0 NON-MEASUREMENT DATA ACQUISITION.....	4
5.0 FIELD ACTIVITIES.....	4
6.0 FIELD OPERATIONS DOCUMENTATION	5
7.0 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS	9
8.0 INVESTIGATION DERIVED WASTE (IDW).....	9
9.0 FIELD ASSESSMENT/THREE PHASE INSPECTION PROCEDURES.....	10
10.0 NONCONFORMANCE/CORRECTIVE ACTIONS.....	10

PREFACE

Shaw Environmental, Inc, a CB&I company(Shaw) has been tasked under its Rapid Response contract with the U.S. Army Corps of Engineers Omaha District (USACE Rapid) Contract No. W9128F-12-D0003, Task Order 0002 to perform residential property remedial actions and possibly continue to conduct residential property investigations within an area designated as the Vasquez Boulevard Interstate 70 (VB/I-70) Superfund Sites, located in Denver Colorado. The work is being performed by Shaw for USEPA Region 8 under the inter-agency agreement in place between USACE and USEPA. This Sampling and Analysis Plan (SAP) for the Final Residential Surface Investigations and remedial actions, VB I-70 Superfund Site outlines all anticipated sampling and analysis procedures that may be used and the requirements, quality objectives and measures necessary to ensure that all data is of a known and sufficient quality to support the intended decisions. Since the work is a continuation of the processes performed under a previous planning document, where applicable procedures and documents have been directly taken or modified from; *Project Plan for the Vasquez Boulevard and I-70 Site, Denver Colorado, Phase III Field Investigation, August 1999*. This SAP has been written to conform to current project planning document requirements and is presented in two parts:

- Part 1 - the Field Sampling Plan (FSP)
- Part 2 - the Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP) for the Final Residential Surface Investigations, VB I-70 Superfund Site

The FSP is presented in Sections 2 through 10. The UFP-QAPP is presented as a series of worksheets which follow Section 10. Where applicable, FSP sections reference UFP-QAPP worksheets. The USEPA Region VIII QAPP/planning document checklist is provided for reference. This SAP provides the guidelines for the systematic data collection and analysis associated with the project. In accordance with the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP, USEPA, 2005b), the QAPP portion of this SAP includes 37 worksheets that detail various aspects of the environmental investigation process and establishes protocols to allow for comparability and defensibility of sampling and analytical data. This SAP adheres to the program requirements of the Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.2, 25 October 2010 and, EM 200-1-3. This revised SAP addresses the requirements for completion of the investigations and any related remedial activities. It will be revised and amended as project scope requires.

PART 1 – FIELD SAMPLING PLAN

1.0 PROJECT BACKGROUND

The project background is presented in UFP-QAPP worksheet 10.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization and responsibilities along with a project organization chart are presented in UFP-QAPP worksheet 5.

3.0 PROJECT SCOPE AND OBJECTIVES

The scope of the project is to complete the removal action within properties (15) that have been identified as requiring action and have granted access. During the task EPA intends to keep the option open to residents/owners to allow access for investigative sampling of all of the residential use properties within the Vasquez Boulevard and I-70 site identified by EPA as having not been sampled during the previous efforts. The removal actions and sampling will be conducted in accordance with the procedures used during the previous efforts. The objective of the sampling is to determine if each residential use property investigated poses a risk to current and future occupants from arsenic and/or lead impacts to surficial (0-2 inches) soils. Risk will be determined by a comparison of the upper confidence limit of the mean within a property at 95-percent confidence (UCL-95) to previously determined site-specific risk based clean up levels. This FSP details the specific procedures related to environmental sampling of the surface soils within properties to provide data that allows for statistical and defensible determination of the UCL-95.

Since any exterior lead-based paint (LBP) present on a property could potentially re-contaminate soils that were remediated and also be a risk factor for current and future child occupants, any property found to contain impacted soils above action-levels will also be evaluated and if necessary abated for exterior LBP. All exterior LBP assessment and/or abatement will be completed prior to any required soil removal, and conducted in accordance with State of Colorado requirements and by certified LBP inspection/abatement personnel.

Properties will be backfilled and returned to their original state to the best possible degree. To ensure that the imported fill materials do not in themselves pose a risk chemical testing will be performed on the source materials and compared to the site action-limits for arsenic and lead and the current EPA RSL table values for residential use properties for additional chemicals; volatile organics, semi-volatile organics; including poly nuclear aromatics, pesticides, herbicides, and metals. In addition, top soil materials will be tested for agricultural properties to ensure that they will provide an adequate growing medium.

Finally, waste characterization sampling will be conducted to allow for proper disposal of all remediation and investigation derived waste (IDW) according to the applicable federal, state and local regulations. This goal will be achieved by collecting, preserving, and analyzing IDW samples properly as detailed in the project Waste Management Plan, which is Appendix B to this document. Further details, including the action-levels, are provided in UFP-QAPP worksheet #11.

3.1 Applicable Standards and Regulations

The SAP has been developed in accordance with the following standards:

- *Record of Decision, Vasquez Boulevard/Interstate 70 Superfund Site, Operable Unit 01, Residential Soils*, United States Environmental Protection Agency, Region 8, September 25, 2003
- *Uniform Federal Policy for Quality Assurance Project Plans, Evaluation, Assessing and Documenting Environmental Data Collection and Use Programs. Part I*, UFP-QAPP Manual, EPA-505-B-04-900A, Final, Version 1, March 2005; EM 1110-1-4009 (U.S. Army Corps of Engineers [USACE], 2007) EM 200-1-3 (USACE, 2001).
- Regulation 19, *Lead-based Paint Abatement*, Colorado Department of Public Health and Environment, 2003

4.0 NON-MEASUREMENT DATA ACQUISITION

The non-measurement data acquisition information to be utilized in performance of the task includes the current EPA data-base of properties, maps showing sampled and remediated properties, and current ownership records in city/county data-systems. UFP-QAPP worksheet 13 provides greater detail as to the types of non-measurement data, criteria for use, and limitations on decisions derived solely from past data.

5.0 FIELD ACTIVITIES

Specific field activities to be conducted include:

For property removal actions

- LBP survey of any properties constructed before 1978
- Lead abatement of any such properties identified to be impacted with exterior LBP containing lead above the State of Colorado removal required concentration.
- Measurement of property dimensions, documentation of pre-removal status, and identification cataloging of any property elements such as plants, landscaping materials, and sprinkler systems requiring replacement and/or reimbursement. These are CQM tasks that will be executed and documented in accordance with the project Construction Quality Management Plan and not discussed further in this document
- Removal of all soils within the property in accordance with the ROD specifications
- Measurement/documentation of compliance with the ROD specifications-again a CQM function
- Backfill and restoration of the property

As additional properties allow access for investigation the task will include;

- Measurement of targeted property dimensions
- Determination and mapping of sampling areas
- Distribution of the 30 sample locations along applicable sample areas
- Collection of the three 10-point composites per property
- If present, collection of separate 5-point composites from gardens and flower bed areas
- Submittal to the EPA CLP network of all samples for analysis of Arsenic and Lead via ICP methods.
- Calculation of the UCL-95 values for arsenic and lead and comparison to the project risk-based decision levels

- For any properties where a “remediate” decision is reached, a follow-up survey will be conducted for exterior LBP. This will be performed during the planned removal action phase in 2013 by a LBP inspector certified in the State of Colorado.

Details for all field activities are provided in UFP-QAPP worksheet #14 and the Standard Operating Procedures (SOPs), taken directly from the previous planning document (1999) and are presented in Attachment 2 of the QAPP.

6.0 FIELD OPERATIONS DOCUMENTATION

Field documentation will be performed as specified in QAPP worksheet #27 and in the Standard Operating Procedures (SOPs) that are presented in Attachment 2 of the QAPP. This field documentation will include programmatic documents such as the Daily Quality Control Report (DQCR) required under the contract with USACE and project-specific logs and log sheets, which have been taken directly from the approved 1999 project planning documents.

6.1 Daily Quality Control Reports

Each day that field work occurs, daily quality control reports (DQCRs) will be prepared, dated, and signed by the Quality Control (QC) Manager and provided to the USACE Contracting Officer and/or the Contracting Officer’s Representative (COR) and the project file. All pertinent field notes, field forms, digital photos, and other field reports generated on a daily basis will be appended to the DQCR. Each DQCR is to be assigned and tracked by a unique number comprised of the Delivery Order number followed by the date expressed as DDMMYY. The DQCR will include weather information at the time of sampling, field instrument measurements, calibrations, identification of all field and quality control samples taken, the status of each sample, departures from the SAP, any problems encountered, and on-site verbal or written instructions authorized from government personnel. The DQCR will announce planned activities such as Preparatory and Initial Inspections and provide results of those inspections. Any deviations from planned activities or corrective actions will be noted in the DQCR. Any deviations that may affect data quality objectives will be conveyed to the COR/CO immediately.

6.2 Field Logbook and/or Sample Field Sheets

Each sampling team will maintain a logbook throughout the project sampling time-frame. Its primary purpose is to provide documentation of activities that have occurred in the field on any given day including the conditions or activities that affected the fieldwork. The logbook will be bound with

numbered pages. All pertinent information regarding the site activities will be documented as near to real-time as possible. Entries in the logbook will be signed and dated. The following is a partial list of the types of information that may be recorded in the logbook:

- Name and title of author; date and time of entry; and physical/environmental (weather included) conditions during the daily field activities;
- Names of field personnel;
- Sampling activity purpose and plan;
- Type of sampled media (surface soil);
- Sample collection method (i.e. 10-point composite);
- Number, type, and volume of samples taken;
- Sample identification (ID) number of each composite sample-reference property sample sheet/map;
- Analysis, number of containers, and preservation required;
- Date and time each grab sample was collected;
- Date and time of composite creation and containerization
- Description of sample collection activities and samples; and
- Documentation of IDW, including contents and volume of waste generated storage, and disposal methods.

All entries will be made in permanent, waterproof ink. Any corrections made in the logbook will be marked through with a single line, dated and initialed.

6.3 Photographic Records

Photographs taken during field activities will be downloaded to the field office computer. When photographs are taken, they will be documented in the Field Logbook, along with a description of where the photograph was taken and the orientation of the photographer. Whenever possible, the name of the digital photo file will be changed electronically to the description of the photo so that the file name becomes the photo log. All digital cameras used should have the date and time stamp feature enabled on the camera and the photographer should ensure that this information is correct before use.

6.4 Sample Documentation

Sample documentation requirements are listed in worksheet #29 of the UFP-QAPP and in the specific SOPs for sample collection attached to this SAP. The requirements include specifics for sample numbering/identification, layout of sample locations, logging of actual sample information, and maintenance of sampling status, results, and remediation decisions for the targeted properties.

6.4.1 Sample Description/Numbering

A sample numbering system will be used to uniquely identify each sample collected. This includes the individual grab samples for each investigative 10-point composite, any LBP samples, backfill source samples, IDW, and all QC samples. The numbering system will provide a tracking procedure to allow retrieval of information about a particular location and to ensure that each sample is uniquely labeled. The sample number for property investigation will be incorporated into a sample description comprised of four elements and formatted as follows:

Property Address	Street Name.	Composite ID	Grab ID
#####	XXXXXX	(A-C)	XX(1-10)

- 1. Property Address:** Alphanumeric identification from actual property signage and/or plot maps.
- 2. Street Name:** Up to six alphanumeric characters as an abbreviation of the street name.
- 3. Composite ID:** One character alphabetical designation of the individual 10-point composites (3) collected at each property. Flower bed/garden composites will be assigned the next sequential alpha values (D-?).
- 4. Grab ID:** Two character alphanumeric identifier for each individual grab sample associated with a composite.

Any samples sent off-site associated with LBP assessment will be identified in the same fashion as the property investigation samples (Property address-Street name-###).

Backfill source samples will be identified as;

BCK-Type-### with type being;

TPS- for topsoil,

RCK for rock/gravel,
or FLL for non-topsoil material

IDW samples including remediation waste will be identified as;

IDW-matrix-###

Contract Laboratory Program Specifics

All samples not for agricultural parameters will be shipped to CLP facilities for analysis in accordance with the CLP requirements for sample identification, labeling, and documentation. The EPA Scribes™ system utilized by USEPA Region 8 assigns pre-determined and sequential sample identifiers. The site specific ID information will be included in the applicable field of the Scribes™ log-in process. QC such as MS/MSD samples will be tagged accordingly in the Scribes system, both in the sample ID and on labels/documentation records.

QC Sample Identification

Field QC samples, consisting of field duplicates and field blanks (clean sand), for additional investigation only will be kept blind to the CLP labs by simply assigning them a non-existent number which would be next in the progression of sample identifiers; for example, a composite identifier of "M". This will maintain a blindness as to the QC nature of the sample per USACE requirements. Equipment rinseate blanks would introduce a non-site matrix to the analyses and due to the significantly lower detection-limits in liquids provide data difficult to evaluate against objectives. Therefore, the project will utilize clean sand field blanks to ascertain whether or not the decontamination procedures are adequate. These will be cross-referenced to a unique ID in the project data-management system which associates each one with the date and sample team. Each sample team will collect a field blank on a daily basis and the project tracking ID will consist of FB-team ID-date. No field duplicates are planned for the backfill or disposal profile tasks, as only 1-2 samples are expected for each.

6.4.2 Sample Labels

Sample labeling will be performed as specified in SOP FS-006 in Attachment 2 of the QAPP and summarized in QAPP worksheet #27. Per USACE policy, all sample labels will be covered with transparent tape to prevent loss of information.

6.4.3 Sample Collection Documentation

Sample collection will be documented in Field logs books, FADLs, and by Chain of Custody. LBP survey documentation will be performed in accordance with the State of Colorado requirements.

Sample collection for the investigation sampling will be documented on the specific forms and sheets created for the project. These are contained in the SOPs attached to the UFP-QAPP and taken directly from the 1999 project planning documents. They are listed in UFP-QAPP worksheet #29 and include:

- Property Sample Layout/Field Diagram
- Surface Soil Data Sheet

6.5 Documentation Procedures, Data Management and Retention

Following all site activities, all field documentation will be scanned and transferred to the Shaw web-portal specifically created for the project. Originals will be maintained for inclusion in the Site-Specific Final Report and the project-specific data-base and data management system, as provided by EPA. The EPA data-base provides for the ability to store pdf documents and all pertinent data will be added to the data-base as directed by USACE/EPA. Per Shaw record retention policies, all project files will be maintained electronically in the designated Shaw Records storage portal for seven years or longer if EPA and/or USACE directs. Shaw will provide electronic files for all field and laboratory data in the final report which can be maintained by EPA as long as desired. Original laboratory analytical records will be maintained by the CLP laboratories in accordance with the CLP requirements, worksheet #14.

7.0 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Sample packaging and shipping will be performed as specified in QAPP worksheet #27 and in SOP FS-012 located in Attachment 2 of the QAPP. No shipment of samples as dangerous goods is anticipated as being required at this time. The LBP subcontractor is using a local laboratory, Reservoir Environmental, Inc and will hand deliver any LBP samples for analysis.

8.0 INVESTIGATION DERIVED WASTE (IDW)

The possible IDW sample analyses are presented in **Table E-1**. Limited analyses may be performed based upon the requirements of the facility that receives the waste. IDW including soils removed from properties will be sampled and characterized as discussed in worksheet 14 of the UFP-QAPP and the attached SOP, *Soil Sampling*, modified from the PRI procedure utilized the last time property removals were conducted.

Table E-1
IDW Sample Analyses-from following

Parameter	Method	Purpose
pH (soil and aqueous)	CLP SOW	Waste Characterization
TCLP (soil preparation)	CLP SOW	Waste Characterization
Metals (soil and aqueous)	CLP SOW	Waste Characterization
VOCs(soil and aqueous)	CLP SOW	Waste Characterization
SVOCs (soil and aqueous)	CLP SOW	Waste Characterization
Pesticides and PCBs (soil and aqueous)	CLP SOW	Waste Characterization
Herbicides (soil and aqueous)	CLP SOW	Waste Characterization
Oil and Grease (aqueous)	EPA-1664-CLP SOW modified	Waste Characterization

9.0 FIELD ASSESSMENT/THREE PHASE INSPECTION PROCEDURES

The field assessment/three phase inspection procedures are discussed in UFP-QAPP worksheet 31.

10.0 NONCONFORMANCE/CORRECTIVE ACTIONS

UFP-QAPP worksheet #32 contains the nonconformance/correction action procedures.

PART 2 – QUALITY ASSURANCE PROJECT PLAN

Table of Contents

EXECUTIVE SUMMARY	VI
SAP/QAPP WORKSHEET #1 – TITLE PAGE	1-1
SAP/QAPP WORKSHEET #2 – SAP/QAPP IDENTIFYING INFORMATION	2-1
SAP/QAPP WORKSHEET #3 – DISTRIBUTION LIST	3-1
SAP/QAPP WORKSHEET #4 – PROJECT PERSONNEL SIGN-OFF SHEET	4-1
SAP/QAPP WORKSHEET #5 – PROJECT ORGANIZATION CHART	5-1
SAP/QAPP WORKSHEET #6 – COMMUNICATION PATHWAYS	6-1
SAP/QAPP WORKSHEET #7 – PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS TABLE	7-1
SAP/QAPP WORKSHEET #8 – SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE	8-1
SAP/QAPP WORKSHEET #9 – PROJECT SCOPING SESSION PARTICIPANTS SHEET	9-1
SAP/QAPP WORKSHEET #10 – PROBLEM DEFINITION	10-1
SAP/QAPP WORKSHEET #11 – PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS	11-2
SAP/QAPP WORKSHEET #12 – MEASUREMENT PERFORMANCE CRITERIA TABLE	12-1
SAP/QAPP WORKSHEET #13 – SECONDARY DATA CRITERIA AND LIMITATIONS TABLE	13-3
SAP/QAPP WORKSHEET #14 – SUMMARY OF PROJECT TASKS	14-1
SAP/QAPP WORKSHEET #15 – REFERENCE LIMITS AND EVALUATION TABLE	15-1
SAP/QAPP WORKSHEET #16 – PROJECT SCHEDULE / TIMELINE TABLE-QUALITY TASKS	16-1
SAP/QAPP WORKSHEET #17 – SAMPLING DESIGN AND RATIONALE	17-1
SAP/QAPP WORKSHEET #18 – SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE	18-1
SAP/QAPP WORKSHEET #19 – ANALYTICAL SOP REQUIREMENTS TABLE	19-1
SAP/QAPP WORKSHEET #20 – FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE	20-1
SAP/QAPP WORKSHEET #21 – PROJECT SAMPLING SOP REFERENCES TABLE	21-1
SAP/QAPP WORKSHEET #22 – FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE	22-1
SAP/QAPP WORKSHEET #23 – ANALYTICAL SOP REFERENCES TABLE	23-1
SAP/QAPP WORKSHEET #24 – ANALYTICAL INSTRUMENT CALIBRATION TABLE	24-1
SAP/QAPP WORKSHEET #25 – ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE	25-1
SAP/QAPP WORKSHEET #26 – SAMPLE HANDLING SYSTEM	26-1
SAP/QAPP WORKSHEET #27 – SAMPLE CUSTODY REQUIREMENTS TABLE	27-1
SAP/QAPP WORKSHEET #28 – LABORATORY QC SAMPLE TABLE	28-1
SAP/QAPP WORKSHEET #29 – PROJECT DOCUMENTS AND RECORDS TABLE	29-1
SAP/QAPP WORKSHEET #30 – ANALYTICAL SERVICES TABLE	30-1
SAP/QAPP WORKSHEET #31 – PLANNED PROJECT ASSESSMENTS TABLE	31-1

Table of Contents (continued)

SAP/QAPP WORKSHEET #32 – ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES	32-1
SAP/QAPP WORKSHEET #33 – QA MANAGEMENT REPORTS TABLE	33-1
SAP/QAPP WORKSHEET #34 – VERIFICATION (STEP I) PROCESS TABLE	34-1
SAP/QAPP WORKSHEET #35 – VALIDATION (STEPS IIA AND IIB) PROCESS TABLE	35-1
SAP/QAPP WORKSHEET #36 – ANALYTICAL DATA VALIDATION (STEPS IIA AND IIB) SUMMARY TABLE..	36-1
SAP/QAPP WORKSHEET #37 – USABILITY ASSESSMENT	37-1
REFERENCES	

Appendix A – 1999 Document

Appendix B – Waste Management Plan

Attachments

Attachment 1 – Forms

- Shaw Property Layout form
- Shaw Sample Data Sheet
- Shaw Property Package Checklist
- Chain of Custody form

Attachment 2 – Standard Operating Procedures (SOPs)

From 1999 Planning document

- ISSI-VBI70-02 Residential Soil Sampling for Yards and Schools, and Parks-modified by Shaw 2012
- ISSI-VBI70-05 Data Entry
- MK-VBI70-07 Decontamination
- MK-VBI70-04 Investigative Derived Waste Management

Shaw Procedures

- EID-FS001 Field Logbook
- EID-FS002 Field Logsheet
- EID-FS005 Custody Seals
- EID-FS006 Sample Labeling
- EID-FS102 Surface Soil Sampling Using a Bulb Planter
- EID-FS011 Composites
- EID-FS020 Data Usability Review
- EID-FS012 Shipping and Packaging of Non-Hazardous Samples
- PRI Soil Sampling
- PRI Fill Materials

Attachment 3 – Colorado State University Procedures

- Western States Agricultural Laboratory Exchange Program suggested Soil and Plant Analytical Methods
- Hexavalent Chrome in soil EPA Method 3060A

Acronyms and Abbreviations

°C	degrees Celsius
CFR	Code of Federal Regulation
CLP	Contract Laboratory Program
cm ²	centimeter squared
CO	Contracting Officer
COC	chain-of-custody
COR	Contracting Officer's Representative
CVAA	cold vapor atomic absorption
DL	detection limit
DoD	U.S. Department of Defense
DOT	Department of Transportation
DQCR	Daily Quality Control Reports
DQI	data quality indicator
DUR	data usability report
EDD	electronic data deliverable
FSP	Field Sampling Plan
H&S	health and safety
IATA	International Air Transport Association
ICAL	initial calibration
ICP	inductively coupled plasma
ICP-AES	inductively coupled plasma atomic emission spectrometry
ID	identification
IDW	investigation derived waste
ISTD	Internal Standard
kg	kilogram(s)
LBP	Lead Based Paint
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MB	method blank
mg	milligram(s)
mg/kg	milligrams per kilogram
mg/L	milligrams per Liter
MQO	measurement quality objective
MS/MSD	matrix spike / matrix spike duplicate
PDS	post digest spike
PM	Project Manager
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality System Manual
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
ROD	Record of Decision
RPD	relative percent difference
RSD	relative standard deviation
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan

Acronyms and Abbreviations

Shaw	Shaw Environmental & Infrastructure, Inc.
SOP	Standard Operating Procedure
TBD	to be determined
TCLP	toxicity characteristic leaching procedure
TR	Traffic Report
UCL	Upper Confidence Limit
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
XRF	X-ray Fluorescence
ZHE	Zero Headspace Extraction vessel

EXECUTIVE SUMMARY

Shaw Environmental, Inc., a CB&I company, (Shaw) has been tasked under its Rapid Response contract with the U.S. Army Corps of Engineers Omaha District (USACE Rapid) Contract No. W9128F-12-D0003, Task Order 0002 to conduct residential property removal actions and investigations within the Vasquez Boulevard/I-70 Superfund Site in Denver, Colorado. The following pages contain the UFP-QAPP worksheets and encompass the Quality Assurance Project Plan portion of the *Final Residential Surface Investigations; VB I-70 Superfund Site*.

Since the work is a continuation of the processes performed under a previous planning document, where applicable, procedures and documents have been directly taken or modified from; *Project Plan for the Vasquez Boulevard and I-70 Site, Denver Colorado, Phase III Field Investigation, August 1999*. Throughout this document references to the 1999 planning document refer to this previously approved plan.

SAP/QAPP WORKSHEET #1 – TITLE PAGE

Final Sampling and Analysis Work Plan-UFP-QAPP Final Residential Surface Investigation Revised to add Remedial Activities

**Phase III Field Investigation
Vasquez Boulevard and I-70 Site
Denver, Colorado**

**Contract No. W9128F-12-D0003
Task Order No. 002
Interagency Agreement DW96953911**

July 2013

Prepared for:



U.S. Army Corps of Engineers
Omaha District Rapid Response
Building 525 Castle Hall
Offutt AFB, NE 68113

Prepared by:



Shaw Environmental & Infrastructure
16406 US Route 224 East
Findlay, OH 45840

SAP/QAPP WORKSHEET #2 – SAP/QAPP IDENTIFYING INFORMATION

Site Name/Number: VB/I-70 Investigation; Shaw 146543

Site Location: Denver, Colorado

Contractor Name: Shaw Environmental, Inc. (Shaw)

Contract Number: W9128F-12-D0003, Task Order 002

Contract Title: USACE Omaha District Rapid Response

Work Assignment Number: Shaw Project Number 146543

UFP-QAPP Worksheet #2	Required Information	Crosswalk to Related Information
A. Project Management		
<i>Documentation</i>		
1	Title and Approval Page	
2	Table of Contents; SAP/QAPP Identifying Information	
3	Distribution List	
4	Project Personnel Sign-Off Sheet	
<i>Project Organization</i>		
5	Project Organizational Chart	Now includes LBP sub and sub lab
6	Communication Pathways	As above
7	Personnel Responsibilities and Qualifications Table	Includes POCs for LBP
8	Special Personnel Training Requirements Table	
<i>Project Planning/ Problem Definition</i>		
9	Project Planning Session Documentation (including Data Needs tables); Project Scoping Session Participants Sheet	
10	Problem Definition, Site History, and Background. Site Maps (historical and present)	1999 planning document, section 1.2 Added discussion on LBP, waste disposal, and fill certification
11	Site-Specific Project Quality Objectives	1999 planning document, section 2.1 Added discussion on LBP, waste disposal, and fill certification
12	Measurement Performance Criteria Table	Section 4.8, 1999 planning document Added criteria related LBP, fill , and waste analysis
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	EPA Property Status data-base
14	Summary of Project Tasks	FSP Sections 5-8 Added discussion on LBP, waste disposal, and fill certification
15	Reference Limits and Evaluation Table	Section 4.9 of 1999 planning document Added limits for waste disposal, and fill certification-EPA RSLs-2012
16	Project Schedule/Timeline Table	Added tasks pertaining to LBP, waste disposal analysis, and fill certification

UFP-QAPP Worksheet #2	Required Information	Crosswalk to Related Information
B. Measurement Data Acquisition		
<i>Sampling Tasks</i>		
17	Sampling Design and Rationale	Section 2.1 of 1999 planning document Added discussion on LBP, waste disposal, and fill certification
18	Sampling Locations and Methods/ Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	Worksheet 14, Section 14.3, SOP in Attachment 2, Section 3.4 of 1999 document
19	Analytical Methods/SOP Requirements Table	Added methods required for waste disposal, fill cert and LBP
20	Field Quality Control (QC) Sample Summary Table	
21	Project Sampling SOP References Table Sampling SOPs	Attachment 2, selected/modified from Appendix F of 1999 planning document Added additional required for LBP, fill certification and waste-modified from PRI 2002 documents
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	
<i>Analytical Tasks</i>		
23	Analytical SOPs Analytical SOP References Table	CLP SOW for Inorganics CLP SOW for Inorganics Hexavalent chromium Agricultural Lead-paint
24	Analytical Instrument Calibration Table	CLP SOW for Inorganics CLP SOW for Inorganics CLP SOW for Inorganics Hexavalent chromium Agricultural Lead-paint
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	CLP SOW for Inorganics CLP SOW for Inorganics CLP SOW for Inorganics Hexavalent chromium Agricultural Lead-paint
<i>Sample Collection</i>		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	FSP, Sections 6, and 7

UFP-QAPP Worksheet #2	Required Information	Crosswalk to Related Information
27	Sample Custody Requirements, Procedures/SOPs, Sample Container Identification	FSP, Section 6 Added discussion on hand delivery of LBP samples to sub selected local laboratory
<i>Quality Control Samples</i>		
28	QC Samples Table Screening/Confirmatory Analysis Decision Tree	
<i>Data Management Tasks</i>		
29	Project Documents and Records Table	FSP, Section 6
30	Analytical Services Table Analytical and Data Management SOPs	Worksheet 14, Section 14.8
C. Assessment Oversight		
31	Planned Project Assessments Table Audit Checklists	
32	Assessment Findings and Corrective Action Responses Table	
33	Quality Assurance (QA) Management Reports Table	
D. Data Review		
34	Verification (Step I) Process Table	Worksheet 14, Section 14.8
35	Validation (Steps IIa and IIb) Process Table	Worksheet 14, Section 14.8
36	Validation (Steps IIa and IIb) Summary Table	Worksheet 14, Section 14.8
37	Usability Assessment	Worksheet 14, Section 14.8

SAP/QAPP WORKSHEET #3 – DISTRIBUTION LIST

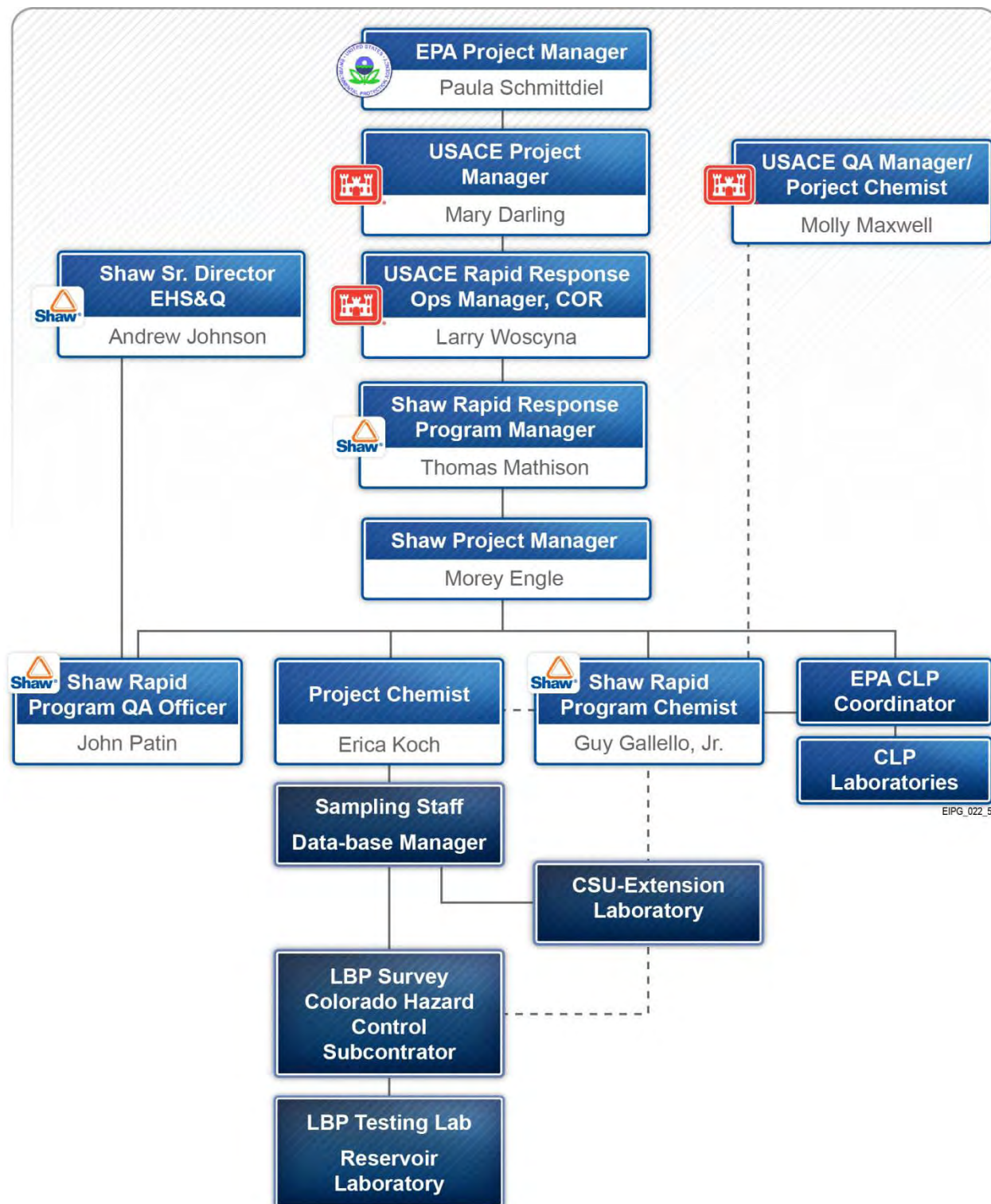
NAME/ORGANIZATION	PHONE #S	E:MAIL ADDRESS	MAIL CODE	
Paula Schmittiel, EPA Remedial Project Manager	303-312-6861 (W) 720-951-0795 (C)	schmittiel.paula@epamail.epa.gov	8EPA-SR	
Richard Sisk, EPA attorney	303-312-6638	sisk.richard@epamail.epa.gov	8ENF-L	
Jennifer Chergo, EPA CIC	303-312-6601	chergo.jennifer@epamail.epa.gov	8OC	OUs 01 & 02
John Works, EPA Enforcement Specialist	303-312-6196	works.john@epamail.epa.gov	8ENF-RC	
Fonda Apostolopoulos, PE - CDPHE	303-692-3411	fonda.apostolopoulos@state.co.us	HMWMD-RP-B2	
Linda Himmelbauer, EPA QA	303-312-6020	himmelbauer.linda@epamail.epa.gov	8TMS-QA	
Mary Darling, USACE Project Manager	402-995-2116 (W) 402-216-4253 (C)	mary.n.darling@usace.army.mil	Omaha District	
Larry Woscyna, USACE Operations Manager/COR	402-661-4269 (W)	Lawrence.J.Woscyna@usace.army.mil	Omaha District	
Molly Maxwell, USACE Project Chemist/QA Manager	402-995-2288	molly.c.maxwell@usace.army.mil	Omaha District	
Tom Mathison, Shaw Program/Project Manager	412-380-6207 (W) 412-401-1309 (C)	tom.mathison@shawgrp.com	Pittsburgh, PA	
Morey Engle, Shaw Project Manager	303-741-7007 (W) 720-480-3204 (C)	morey.engle@shawgrp.com	Centennial, CO	
Guy Gallelo Jr., Shaw Program Chemist	419-425-6080 (W) 419-348-5828 (C)	guy.gallelo@shawgrp.com	Findlay, OH	
John Patin, Shaw Program QA Manager	281-531-3182	john.patin@shawgrp.com	Houston, TX	
Erica Koch, Shaw Project Chemist	303-915-8455 (C)	erica.koch@shawgrp.com	Centennial, CO	

SAP/QAPP WORKSHEET #4 – PROJECT PERSONNEL SIGN-OFF SHEET

The Project Personnel Sign-Off Sheet documents that key project personnel overseeing and/or performing site work have read the applicable sections of the SAP/QAPP and will perform the sampling and analysis tasks as described.

Project Personnel	Organization/Title/ Role	Telephone Number	Signature*	Date SAP/QAPP Read
Paula Schmittiel	EPA Remedial Project Manager	303-312-6861 (W) 720-951-0795 (C)		
Mary Darling	USACE Project/ Manager	402-995-2116 (W) 402-216-4253 (C)		
Larry Woscyna	USACE Rapid Response	402-661-4269 (W)		
Molly Maxwell	USACE Project Chemist/QA Manager	402-995-2288 (W)		
Tom Mathison	Shaw Program Manager	412-380-6207 (W) 412-401-1309 (C)		
Morey Engle	Shaw Sr. Project Manager	303-741-7007 (W) 720-480-3204 (C)		
Guy Gallelo	Shaw Program/QA Chemist	419-425-6080 (W) 419-348-5825 (C)		
John Patin	Shaw Program QA Manager	281-531-3182		
Erica Koch	Shaw Project Chemist	303-915-8455		

SAP/QAPP WORKSHEET #5 – PROJECT ORGANIZATION CHART



SAP/QAPP WORKSHEET #6 – COMMUNICATION PATHWAYS

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Point of Contact with EPA	USACE Project Manager Shaw Project Manager	Mary Darling Morey Engle	404-995-2116 303-741-7007	Due to the interagency agreement EPA communication will be through USACE unless USACE authorizes direct communication.
Point of Contact with CDPHE and City of Denver	USEPA Project Manager	Paula Schmittiel	303-312-6861	All contact with the State of Colorado and the city of Denver will be through USEPA.
Point of Contact with USACE	Shaw Project Manager Shaw Program Manager	Morey Engle Tom Mathison	303-741-7007 412-380-6207	All documents and information are forwarded to USACE by the Shaw PM or designee.
Project Management Actions	Shaw Program Manager	Tom Mathison	412-380-6207	Maintains communication with all project and task technical lead personnel and communicates with the Shaw PM, at minimum, during the weekly project status meeting and as circumstances require.
Distribution, Revision control, and Changes to Project Documents and Forms	Shaw Program QA Officer	John Patin	281-531-3182	Maintains revision control for all project documents and forms and oversees project documents and records management. All change requests are submitted to Document Control through principal document authors. Documents are issued document revision numbers and uploaded to the Administrative Record for the Project. All document revision slip pages or revised forms are provided to the document/form owner within 10 days following identification of the change. Has responsibility for distribution of this document and assuring that the current revision is in use by all parties.
Changes to QAPP	Shaw Program Chemist Shaw Program QA Officer	Guy Gallelo John Patin	419-425-6080 281-531-3182	Any field change requests, variance requests, or deviations are communicated to the Program Chemist. If a permanent change needs to be implemented, the Program Chemist will make changes within 5 days. The Program QA Manager is responsible for implementing a tracking system (i.e., Variance Tracking Log, Nonconformance Report [NCR] Tracking Log, Corrective Action [CA] Tracking Log, etc.). All QAPP changes require approval of USACE QA Manager and PM
Field Activities	Shaw Project Chemist	Erica Koch	303-915-8455	Copies of daily field activities are emailed or faxed to the Program Chemist on a daily basis and to the Program QA/QC Manager at the end of each month.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Stop Work Because of Safety or Quality	All staff employees and subcontractors have stop work authority related to safety or quality issues	Morey Engle	303-741-7007	All stop work requests are reported immediately to the Shaw Project Manager or designee. Safety issues are also reported directly to the Shaw Health and Safety lead or designee, quality issues related to sampling or analysis are reported to the Shaw Project Chemist, and other quality issues are reported to the Shaw Program Chemist and Shaw Program QA Manager. Shaw Procedure No. EI-Q002, "Stop Work Order," describes the process and responsibilities (a copy is presented in IW QAPP Volume II). USACE PM and/or QA Manager will be notified immediately of any SWO
Temporary Change Requests	Site QA Manager/Project Chemist	Erica Koch	720-554-8179	Requests to make temporary changes to field or other procedures are submitted to the Shaw Project Chemist, who forwards to the Shaw Program Chemist and appropriate individuals for input and approval.
QA/QC Field Change Requests	Quality Control Site Manager/Project Chemist	Erica Koch	720-554-8179	Field changes (i.e., real-time) relating to sampling and analysis are communicated directly to the Project Chemist or the technical lead who will approve the change. All other field changes are communicated to the Project/Task Lead and/or the QA/QC Manager for approval. Field changes are documented in the field records and forwarded as soon as practicable to the Project/Task Lead, QA/QC Manager, and the Project Chemist via fax or email (e.g., within 48 hours). Any field change that will affect the scope, costs, safety, and/or the environment must be approved by project management prior to implementation. The QA/QC Manager is responsible for implementing a tracking system (i.e., Variance Tracking Log, NCR Tracking Log, CA Tracking Log, etc.).
Reporting of Data Quality Issues–Field	Shaw On-Site QC Officer/Project Chemist			All potential data quality issues are reported to the Project Manager, Program Chemist and the Program QA/QC Manager as soon as practicable (e.g., within 48 hours). The USACE and/or QA Manager will be notified within 48-hours of any field changes or quality issues.
Reporting of Data Quality Issues and Corrective action-LBP	Colorado Hazard Control, Inc Lab-Reservoirs Environmental Inc.	Alexis L. Jackson Jeanne Spencer	303-279-1429 303-964-1986	The LBP subcontractor is required to report all quality issues, including those with its subcontract laboratory to the Shaw Project Chemist and to institute corrective actions as directed. LBP laboratory quality issues may also be reported to and managed by the Shaw Program Chemist.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Reporting of Data Quality Issues– Laboratory	CLP Laboratory PM	CLP laboratory specific	TBD	The Laboratory PM reports any QC deficiencies associated with sample receipt or catastrophic loss of sample during analysis to the EPA CLP Coordinator who in turn notifies the Shaw Program Chemist as soon as possible after discovery (e.g., within 24 hours). Any issues that are deemed to seriously effect data usability will be communicated to the USACE PM and/or QA Manager
Corrective Actions– Laboratory	Laboratory QA/QC Manager	CLP laboratory specific	TBD	Any CARs requested to be performed by the laboratory are documented and communicated in writing to the QA/QC Manager and the Program Chemist within 30 days of any request. The QA/QC Manager is responsible for implementing a tracking system (i.e., Variance Tracking Log, NCR Tracking Log, CA Tracking Log, etc.).
Release of Data for Use	Shaw Program Chemist	Guy Gallelo, Jr	419-425-6080	No analytical data is released until reviewed by the Program Chemist.
Data Reporting – Electronic Deliverable	Shaw Project Chemist	Erica Koch	720-554-8179	The Data Manager ensures that electronic deliverable submittals are prepared and submitted on a regular basis and that the EPA property data-base is maintained and updated. The PC may designate a person to perform this task.
Database Issues	Shaw Project Chemist	Erica Koch	720-554-8179	All issues relating to operation or maintenance of the project data-base are directed to the Data Manager/PC or designate.

SAP/QAPP WORKSHEET #7 – PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS TABLE

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Paula Schmittziel	Project Manager	EPA	Responsible for the execution and completion of the planned sampling and other efforts. Coordinates directly with USACE Project Manager and other EPA staff to ensure that project goals are met.	As defined by USEPA
Linda Himmelbauer	QA Manager	EPA	Provides overall QA oversight to the project and responsible for ensuring that the requirements of the ROD and overall EPA programs are met in the execution of the work. Approves QAPP for EPA	As defined by USEPA
Jennifer Chergo	Community Relations	EPA	Serves as primary POC for the site communities and will be primary contact for access permission.	As defined by USEPA
Mary Darling	Project Manager	USACE	The Project Manager is responsible for the overall execution of the Task Order, direction/oversight of the contractor-Shaw, and communication with USEPA.	BS in engineering or similar related discipline and 15+ years of experience managing environmental and/or construction projects
Molly Maxwell	USACE Project Chemist/QA Manager	USACE	Responsible for providing independent QA oversight to the project and support to the USACE PM. Approves all plans and changes, reviews DQCRs, and ensures that all data meets minimum standards for quality and usability necessary to support intended decisions	BS in Chemistry or Environmental Science related field and 10+ years of experience providing data quality and planning support to environmental projects.
Larry Woscyna	Operations Manager, COR	USACE	The Operations manager is responsible for the day to oversight of the execution and cost-efficiency of the work performed by the contractor (Shaw). All daily reporting, including cost and scheduling goes through the COR	BS in Engineering or similar discipline plus 10 years of experience in environmental remediation or construction projects

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Tom Mathison	Program Manager	Shaw	The Shaw Program Manager is responsible for Shaw's performance from a Program perspective. He serves as the primary POC for coordination with USACE and is responsible for the overall execution and cost-effectiveness of the task.	BS in business, engineering, construction, plus 15 years experience
Morey Engle	Project Manager	Shaw	Responsible for daily project execution and cost-control. Serves as primary POC for USACE Operations Manager.	BS in engineering, environmental science or related field plus 5 years of experience or 15+ years of environmental remediation project experience
Guy Gallelo, Jr.	Program Chemist	Shaw	The Program Chemist is responsible for the development and execution of the SAP/QAPP and the overall quality of all sampling and analytical data. This includes review/validation of data, training the sampling staff in executing the plan, and performing all oversight.	BS. In Chemistry plus 5 or more years' experience in providing planning, execution, and oversight of project sampling and analytical programs
Erica Koch	Project Chemist	Shaw	The Project Chemist will be responsible for overseeing all of the site sampling activities, compilation and data-base entry of results, and creation of the DCQCR. The PC will sign-off on all property sampling plans before sample collection begins.	BS in an Environmental related field with 3+ years of field sampling and analytical experience or 5+ years of field sampling and analytical experience
John Patin	Program QA Manager	Shaw	The Program QA Manager will be responsible for distribution and change control of the approved QAPP	BS in engineering, environmental science or related field plus 5 years of experience or 15+ years of environmental remediation project experience. Certification in CQM

SAP/QAPP WORKSHEET #8 – SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates ^a
Environmental Media Sampling	40-Hour Hazardous Waste Site Worker 8-Hour Hazardous Waste Site Worker Annual Refresher 8-Hour Hazardous Waste Site Supervisor Training-Team Leader 10-Hour Occupational Safety and Health Administration (OSHA) Construction Site Worker Safety Training	Varies ^b	Varies ^b	All	Project Safety & Health Manager, Project Chemist Sampling Technicians, USACE personnel on-site	Certification files are maintained on-site during field activities. The Project Manager is responsible for ensuring that all site personnel are properly trained.
Sample packaging shipment	DOT/IATA training	Shaw or approved vendor	Within 2 years of date	Project Chemist Sample shippers	Project Chemist Sample shippers	Certification files are maintained on-site during field activities. The Project Manager is responsible for ensuring that all site personnel are properly trained.
LBP subcontractor	40-Hour Hazardous Waste Site Worker 8-Hour Hazardous Waste Site Worker Annual Refresher Specialized training including radiation protection from XRF manufacturer or approved provider Certification in the State of Colorado to conduct LBP surveys	Varies	Varies	LBP subcontractor	State of Colorado or State approved provider	Subcontractor will be required to submit certification/training records as part of bid process. Records from selected subcontractor will be maintained in project file

^aTraining records and/or certificates will be available in the project files at the Shaw Centennial Office.

^bThe training provider and date of the training may/will vary from person to person and may include Shaw, USACE, or outside providers but is indicated on the individual's certificate

SAP/QAPP WORKSHEET #9 – PROJECT SCOPING SESSION PARTICIPANTS SHEET

Date of Session: June 5, 2012

Scoping Session Purpose: Meeting and site drive-through to view example properties

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Paula Schmittiel	Project Manager	EPA	303-312-6861 (W) 720-951-0795 (C)	schmittiel.paula@epa.gov	Management
Jennifer Chergo	Community Relations Specialist	EPA	303-312-6601	chergo.jennifer@epa.gov	Public Relations
Larry Woscyna	Operations Manager	USACE	402-661-4269	lawrence.j.woscyna@usace.army.mil	Management
Mary Darling	Project Manager	USACE	402-995-2116 (W) 402-216-4253 (C)	mary.n.darling@usace.army.mil	Management
Tom Mathison	Program Manager	Shaw	412-380-6207 (W) 412-401-1309 (C)	tom.mathison@shawgrp.com	Management
Guy Gallelo, Jr.	QA Chemist	Shaw	419-425-6080 (W) 419-348-5828 (C)	guy.gallelo@shawgrp.com	Chemist/QC
Morey Engle	Project Manager	Shaw	303-741-7007 (W) 720-480-3204 (C)	morey.enge@shawgrp.com	Management

Parties discussed the project for several hours coming to agreement on the use of the previously approved project plan as the guide for the UFP-QAPP, scope (at the time including a field XRF lab), the need for identifying properties requiring LBP survey/abatement, Shaw management of the EPA property data-base, and the addressing of flower bed/gardens during this investigation phase. Following lunch, the team conducted a drive-through tour of the site with Ms. Chergo pointing out specific properties that will require investigation. During this time several properties of questionable residential use were identified for EPA follow-up. Parties debriefed and parted at approximately 1700 MST.

SAP/QAPP WORKSHEET #10 – PROBLEM DEFINITION

Purpose and Scope

The purpose of this task is to complete the removal action at all of the properties that have been previously or by way of the recent investigation effort identified as containing soils above the action limits. At the same time, EPA will be gaining access to additional properties that will need to be sampled to determine if remediation is necessary. In order to maintain consistency with past investigation and associated remediation efforts, the procedures and methods developed in the approved 1999 project planning document, *Project Plan for the Vasquez Boulevard and I-70 Site, Denver Colorado, Phase III Field Investigation, August 1999*, attached as Appendix A will be utilized.

Project Location and Description

The VB/I-70 site lies in the north central section of Denver, Colorado. It encompasses portions of four distinct neighborhoods of mixed residential and commercial industrial properties that were surficially impacted by nearby smelting activities. The site entails approximately 4000 total properties and occupies the area bounded by the South Platte River on the west; Colorado Boulevard to the east; East 52nd Avenue to the north; and Martin Luther King Boulevard to the south. A small area south of Globeville and bounded by the South Platte River, Interstate-70, West 39th Huron Street, and the Burlington Northern Railroad is also included in the Superfund Site boundaries. The site has been designated as an Environmental Justice site by EPA Figure 1-2 in the 1999 project planning document, attached to this document and shows the site location and boundaries.

Site History and Descriptions

The site boundary contained two now-defunct smelters and a current smelting operation is situated to the north and west of the site. Studies of the soils throughout the site begun in the 1990s indicated that the smelting operations had deposited contamination onto surface soils throughout the site. EPA actions began in 1998 and a Record of Decision (ROD), *Record of Decision, Vasquez Boulevard/Interstate 70 Superfund Site, Operable Unit 01, Residential Soils* addressing the site was agreed to in 2003.

As part of the study ROD processes, EPA determined site-specific risk-based limits, intended to eliminate exposure of children to surface contamination (0-2 inches) and initiated extensive investigations and remediation actions throughout the site. The last work connected to this process was conducted in 2003 when several properties previously identified as needing clean-up were remediated. Further historical detail can be found in the ROD and various other plans and reports written for the site.

Over the course of previous investigation and remediation activities approximately 130 properties were not sampled and another 30 not remediated due to owner/occupant failure and/or refusal to grant access. These properties were identified in the first five-year review under the ROD, conducted in 2009. The majority of the effected properties have changed ownership and EPA wishes to provide the current owners one more opportunity to allow their properties to be sampled and if necessary remediated, via an additional project Task Order in 2013.

Shaw completed the additional investigation in the fall-winter of 2012 and identified additional properties that require remediation. These properties and any others previously identified for cleanup by EPA will be remediated during this task. In addition, EPA is continuing to allow residents/owners within the boundary to grant access for identified remediation and/or investigation. Thus, during the course of this portion of the project property remediation and investigation activities may be occurring concurrently.

SAP/QAPP WORKSHEET #11 – PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS

The Data Quality Objectives (DQO) process will be utilized to ensure that all project decisions are made using data of a known and sufficient quality to support the decision. The DQOs for this project are based on the extensive objectives established during the past efforts, including those in the approved 1999 planning document, *Project Plan for the Vasquez Boulevard and I-70 Site, Denver Colorado, Phase III Field Investigation, August 1999*, attached as Appendix A. For ease of following the process the next seven sections will discuss and break-out the systematic planning process and objectives as presented in USEPA guidance.

11.1 Step 1-State the Problem

The intent of the project is to complete the remediation and investigation of all remaining properties of a residential nature throughout the VB/I-70 site. A property is considered a hazard and a candidate for remediation if the surface (0-2 inches) soils pose a risk to potential receptors, primarily children. Site-specific risk-based limits have been defined for the two chemicals of concern:

- Arsenic 70 mg/kg
- Lead 400 mg/kg

Additionally, to protect any remedy from re-contamination by exterior LBP, properties requiring action built prior to 1978 will be surveyed for the presence of LBP and abated if necessary before any soil removal action is initiated. The action-levels for survey are:

- LBP
 - 1mg/cm² lead-impact-(EPA will decide course of action if any)
 - 6mg/cm² lead-abatement necessary

Following removal of the impacted soils from any property restoration will require backfill with common fill, topsoil, other rock materials, or mulch. Thus to ensure that these imported materials do not themselves pose a risk to the residents; the materials will be tested for chemical contaminants. The results will be compared to the site action limits (As and Pb) and the EPA Regional Screening Levels for residential use. Material failing any limit will not be utilized as fill. Topsoil will also be tested against agricultural specifications for nutrients, organic content, and physical characteristics and either amended to meet or rejected for use.

11.2 Step 2-Identify the Goal of the Study

The goal of the work is to complete the necessary removal actions and any additional investigation sampling of all to date unsampled residential use properties within the VB/I-70 Superfund Site. The property specific goals are to:

Removal Action

- Conduct LBP survey and collect sufficient samples to comply with Regulation 19 requirements from all exterior surface types of properties constructed prior to 1978
- Complete abatement and conduct post-abatement survey for LBP as required
- Complete the removal of all impacted soils to the ROD specified depths
- Collect sufficient samples of the removed soils to complete waste characterization and comply with TSDF requirements
- Collect data for chemical constituents from the fill and topsoil/dressing materials to compare to EPA RSLs for residential soils

Investigation-as required

- Collect sufficient samples to represent the accessible surface soils.
- Determine the concentrations of arsenic and lead for comparison to previously established action-levels and determination of the need for remediation.
- Collect data of sufficient quality to provide 95% confidence in the comparison decision made for each property investigated.

11.3 Step 3-Identify Information Inputs

In order to complete the stated task, several data inputs will be required. First, the properties not yet remediated and/or sampled will need to be known so that owners/occupants already sampled are not inadvertently inconvenienced again at additional cost to EPA. Second, owner/occupant access must be granted or sampling teams can be considered to be trespassing on private property.

The remediation status decision within a property requires that sufficient samples be collected to reasonably represent the accessible surface soils and that the sample locations be representative of the surface soils. This is a critical data decision and sampling and analysis associated with a property “no remediation decision” requires 95% confidence that COC levels are below the established action-levels.

Additional inputs are required to perform LBP survey and abatement, characterize the removed soils for compliant disposal and to ensure that any imported fill materials will not themselves pose a risk. LBP

survey inputs include field screening (XRF) and off-site analysis as QC to determine the lead mass present in suspect LBP surfaces. Since the project does not have a soil staging area and the planned removal depth is actually to 12-inches, samples collected for waste characterization will be collected insitu from a depth of 0-12 inches to represent the “as received” waste. Backfill materials will be tested for the project COCs and a variety of common and regulated chemicals to ensure that the materials do not contain any targeted chemicals at a concentration above the EPA RSL for residential use and therefore pose a potential risk.

11.4 Step 4-Define the Study Boundaries

The work is to be conducted only in those properties, located within the VB/I-70 site of a residential nature that have been identified as needing remediation or that have not been sampled. Within these properties, the investigative sampling and analytical effort will target surface (0-2 inches) soils only that can be considered accessible to potential child receptors. Based upon the data provided in Appendix A of the approved 1999 planning document, which established the site COCs, arsenic concentrations are expected to be between 5-10,000 mg/kg and lead ranges from 10-4000mg/kg throughout the site.

LBP survey and if required abatement will only be conducted for the exterior paint surfaces of those residences identified as requiring remediation that were constructed prior to 1978, which is the majority of structures in the project boundary.

Samples collected for waste characterization from planned remediation properties will be sampled in place from the planned removal depth (0-12-inches, 24-inches for gardens/flower-beds) so that the profile is completed on soils representative of the waste stream. Samples from fill materials will be collected from a defined stockpile or at determined depths that represent the material that will be utilized. Liquid IDW will be sampled from the storage containers.

11.5 Step 5-Define the Analytical Approach/Decision Rules

Property remediation decisions will be made based upon a comparison of the Upper Confidence Limit (UCL) of the mean concentration values at 95% confidence (UCL-95) for the COCs to the action-levels. The following decision rules apply:

- If the UCL-95 of both arsenic and lead in the accessible surface soils are below the action-levels the property is deemed non-impacted and no remediation is warranted.
- If either or both arsenic and lead UCL-95 concentrations are determined to be above the action-levels, the property requires remedial action to protect potential receptors.

- For properties requiring remediation the soils in any gardens or flower beds need to be compared to the action-levels to determine if they require removal.
- Also, any property for which remediation is required that was built before 1978 needs to be evaluated to see if a risk of recontamination from exterior lead-based paint (LBP) exists. Defined as LBP with lead concentrations above 6 mg/cm².
- Removed soils will require characterization and waste-profiling to dispose of them properly. Data, collected in situ per the approved project procedures, will be compared first to the Land Disposal Restrictions in 40 CFR 261.24 and then any selected facility permit requirements. Decontamination liquids will also require proper profiling for disposal
- Materials for use as fill or to replace decorative landscape will require sampling and analysis to provide assurance that they do not introduce risk. All such materials, including gravel/rock used for both fill and decoration, soils, topsoil, and even mulch will be tested and compared to the site limits for the two COCs (As and Pb). In addition, topsoil materials will be tested for metals, volatile organics, semi-volatile organics; including low-concentration PAHs, pesticides, PCBs, herbicides and hexavalent chromium for comparison to the EPA RSL values for residential use.
- Topsoil materials will also be tested for agricultural properties such as, nitrogen/phosphorous content, pH, organic content, iron, potassium, manganese, copper, zinc, lime, and texture to ensure that they provide an adequate growing medium. As part of this testing, any necessary amendments and their recommended addition ratios will be provided.

11.6 Step 6-Specify Performance or Acceptance Criteria

The primary sources of error in the decisions stem from the sample density and sampling and analytical method deficiencies. There is also a secondary concern that the sampling effort closely resemble past events so that residents/owners whose properties were sampled in previous efforts do not sense a change in the process.

Sample Density – Sample locations and the spacing between samples are important in ensuring that the samples analyzed, even if composited, represent the accessible surface soil areas. Concerns in this area have been addressed by an aggressive sampling design which targets only those areas of the property with accessible surface soils and distributes a significant number of sample locations over those areas in a manner where density in each defined zone is a function of the percent of the total accessible area contained within it.

In addition, the use of multiple composite samples provides for the multiple data points required to determine the UCL-95 while controlling costs. The composite point location has been designed to assign grab sample locations from similar multiple defined zones into each composite. In this way, each composite analyzed represents soils from all accessible zones of the property.

Sample density, both screening and off-site/QC for LBP assessment will follow the requirements of Colorado Regulation 19.

Samples collected for waste characterization of the removed soils will also be composites (except for TCLP/VOCs) and will be selected from a sub-set of the properties. In order to limit analytical costs while providing data on multiple properties, composites for analysis will actually be composites of multiple (4) property composites with TCLP/VOCs being determined on 4 X 5g grabs from each selected property, lab composited into a single ZHE. Sample depths will be from 0-12-inches (24 for gardens/beds) to mimic the actual planned removal depth. VOC samples will be collected from soils at least 3-inches deep to make sure that surface weathered materials that may have lost volatiles are not sampled.

Waste liquid profiles will be collected from the storage containers. If small containers such as drums are used, the Contract Regulatory Specialist will specify any grouping/compositing to be performed. Samples for VOC or TCLP/VOCs will be grabs to preserve VOC integrity

Sampling and Analytical Methods – In order to limit errors in these areas and to provide data comparable to past efforts, the same sampling and analysis procedures will be utilized as in the past events. The sampling designs will be executed in accordance with the 1999 SOP and analytical methods will specify the same quality requirements as were defined in that document, with the added assurance derived from the strict requirements for sample preparation and analysis inherent in the CLP SOW. Where necessary, such as for PAHs that have low EPA RSL values, a request will be made to utilize low-concentration modifications to the CLP SOW.

11.7 Step 7-Develop (Optimize) the Plan for Data Acquisition

To complete the project and ensure that all properties have been sampled or refused sampling and that all remediate/no remediate decisions can be justified, the following will be executed.

- The data-base will be QC checked to make sure residential use properties were not incorrectly misidentified as non-residential.

- The list of no access properties will be checked against the information in the data-base to eliminate double access requests.
- The property access agreements will be filed and the data-base updated as they are received. A separate file of access-granted need sampling properties will be created as the project progress file.
- Properties will be multiple composite sampled in the same manner as past efforts to provide a representative distribution of sample locations and the three composites for analysis.
- Unlike in past efforts, flower bed/garden areas will be composite sampled during the primary investigation. This will provide data as to the need to remove these soils prior to actual removal activities.
- The analysis will be performed using CLP labs for COCs analysis using the preparation and analytical procedures required by the current CLP SOW. The values for each of the three property composites and any associated flower bed/garden composites will be compared to ensure statistical reasonableness prior to UCL-95 determination. Note; it is anticipated that flower bed/gardens will only require action when the actual property decision is to remove impacted soils. However, flower bed/garden composites will be analyzed concurrently with their associated properties.
- The project data-base will be updated continuously as properties are accessed/sampled and results received.
- Property owners/occupants will be notified of remediation status/need in a timely fashion.
- Properties identified as requiring removal will be referenced in the data-base for the year constructed.
- Each such property constructed prior to 1978 will be inspected for exterior LBP by a Colorado certified LBP inspector who will follow all of the Rule 19 requirements. The decision to abate will be made by comparison to the rule 19 removal standard or any other criterion as determined by the inspector. Details are provided in the separate LBP Assessment and Abatement Work Plan developed by the subcontractor
- Any abatement will be completed in accordance with Rule 19 requirements and before property soil removal. This will ensure that the property soils are not removed until the potential threat from exterior LBP has been eliminated. Details are provided in the separate LBP Assessment and Abatement Work Plan developed by the subcontractor
- Soil removal is a performance based activity and the only measurements will be before and after survey to confirm removal depths and completeness. These will be performed as a CQM activity and not discussed in this QAPP.

- Waste profile samples will be collected in the same manner as they were during the 2003 RA; in situ from four of each twenty properties remediated. The four properties will be randomly selected and the samples will be collected from the planned removal depth (0-12-inches) to provide data on the as received material.
- Waste liquid profiles will be collected from the storage containers. If small containers such as drums are used, the CRS will specify any grouping/compositing to be performed. Samples for VOC or TCLP/VOCs will be grabs to preserve VOC integrity.
- Fill materials will be grab sampled once per 5000cy or source. VOCs samples will be submitted as a 5-gram plug in an empty pre-weighed VOC vial per SW-5035A.
- Analysis methods for waste-profiling and fill material chemical analysis will be performed via the CLP. Agricultural properties will be determined by the Agricultural testing facility at the CSU-extension using approved ASTM and agricultural society methods, which in some instances are EPA protocols.

SAP/QAPP WORKSHEET #12 – MEASUREMENT PERFORMANCE CRITERIA TABLE

SAP/QAPP Worksheet #12.1 – Measurement Performance Criteria Property Soil Composites and Lead-based Paint

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	Arsenic and Lead via CLP SOW LBP-XRF screen Lead-chip off-site	10% of property composite soil samples collected-does not include garden flower bed/composites Lead-Per Regulation 19 requirements	Precision	<RPD <40 or if near detection limits Absolute difference of two values within 10X MDL	S&A
Equipment Blank- (clean sand)- property investigation only	Arsenic and Lead via CLP SOW USEPA 6010B	One per sampling day per sample team	Bias and Accuracy	As<10 mg/kg, Pb<50 mg/kg	S
Evaluate RSD of three property composites-property investigation only	Arsenic and Lead CLP SOW	Each set of three property specific composites	Precision and potential bias in sample locations	%RSD <50% for three values	Precision in ICP analysis and sample location assignment- Measure representativeness and comparability of composites

Note: In addition to the above field QC samples, laboratory QC samples will be analyzed to assess precision, bias, and sensitivity of an analytical system. Specific requirements for precision, bias and sensitivity are presented in SAP/QAPP worksheet #28. Completeness goals are discussed in worksheet #37.

SAP/QAPP Worksheet #12.2 – Measurement Performance Criteria Table (Soil Matrix, and IDW analyses)

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Laboratory control Blank (LCB)	Arsenic and Lead Metals, TCLP/Metals, TCLP/Volatiles, TCLP/Semi-volatiles, TCLP/Pesticides, TCLP/Herbicides, PCBs, Pesticides/PCBS, Volatiles, Semi-volatiles, Herbicides, agricultural parameters CLP Inorganic SOW CLP Organic SOW LBP-SW-846 6010C	One per batch of 20 or less samples	Bias and Accuracy	No analyte detected >1/2 LOQ or 1/10 of Action-level	A-contamination bias
Laboratory Control Spike (LCS)	Arsenic and Lead Metals, TCLP/Metals, TCLP/Volatiles, TCLP/Semi-volatiles, TCLP/Pesticides, TCLP/Herbicides, PCBs, Pesticides/PCBS, Volatiles, Semi-volatiles, Herbicides, agricultural parameters CLP Inorganic SOW CLP Organic SOW LBP-SW-846 6010C	One per batch of 20 or less samples	Accuracy	Metals 90-110% recovery Organics 45-150% recovery-within CLP SOW limits	A-ability to recover analytes in clean matrix
MS/MSD	Arsenic and Lead Metals, TCLP/Metals, TCLP/Volatiles, TCLP/Semi-volatiles, TCLP/Pesticides, TCLP/Herbicides, PCBs, Pesticides/PCBS, Volatiles,	One per batch of 20 or less samples Site-specific not required for TCLP	Accuracy and Precision	Metals-75-125% Recovery for samples with conc. <4X spike level Organics-35-165%	A-ability to recovery analytes in sample matrix and precision in sample matrix

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
	Semi-volatiles, Herbicides, agricultural parameters CLP Inorganic SOW CLP Organic SOW LBP-SW-846 6010C			recovery, within CLP SOW limits RPD<30	
Temperature Blank	, Metals, TCLP/Metals, TCLP/Volatiles, TCLP/Semi-volatiles, TCLP/Pesticides, TCLP/Herbicides, PCBs, Pesticides/PCBS, Volatiles, Semi-volatiles, Herbicides, agricultural parameters CLP Inorganic SOW	1 per sample cooler-not required for As and lead only samples	Representativeness	0-6°C, unless not required	S

Note: no field QC (duplicates/blanks) will be collected for waste profile and fill/landscape material testing.

SAP/QAPP WORKSHEET #13 – SECONDARY DATA CRITERIA AND LIMITATIONS TABLE

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation / collection dates)	How Data Will Be Used	Limitations on Data Use
Existing EPA data-base developed to track all site/property actions	Maintained and provided by USEPA, 1999-present	Various contractors throughout the property investigation and remediation phases of the project 1999-2003	Data-base will be used to determine those properties requiring sampling.	Data-base may be missing information or have duplicates. Properties identified as residential may have commercial use. Alternatively, commercial properties may have hidden residential elements

EPA is responsible for scrubbing the data-base of duplicates and mis-identified properties and for determining which properties meet the criteria and require access. EPA is also responsible for obtaining grant of access to all required properties. Duplicate properties will be evaluated via the dates of actions entered and purged from the data-base. Duplicates for which information does not match will be added to the "contact" list and if the resident/owner grants access investigated. A percentage of commercial properties that were not investigated/remediated will be drive-by evaluated to confirm commercial use by EPA. If all match commercial use, then the data-base will be considered correct and no properties identified as commercial use will be further evaluated. Properties sampled will be required to be listed as needing investigation, access granted, and also be determined via drive-by to be of a residential use nature. If a property tagged for access does not meet these criteria, EPA will be consulted, via USACE, before proceeding.

SAP/QAPP WORKSHEET #14 – SUMMARY OF PROJECT TASKS

The proposed activities include contacting property owners/residents for access, determining grab sample locations, collecting the property-specific composites, preparing and shipping to the specified CLP facility for analyses of arsenic and lead, and determining the UCL-95 for each property and comparing to the action-levels. Additional activities include entry of the property-specific information and results into the EPA provided property data-base, LBP survey of properties over action-levels, abatement of any LBP issues found, excavation and restoration of all remaining properties identified as having 95-UCL values above the action-limits, adequacy testing of fill/restoration materials, , and disposal of IDW from the removal and sampling activities.

14.1 Gaining Owner/Occupant Access

This task is currently in process and is the responsibility of USEPA Region 8 staff. Following a review and scrubbing of the data-base, residential properties that require investigation will be identified and provided a form letter with a formal access agreement form via U.S. mail. As signed access agreements are returned the properties will be added to the list of properties to be accessed by Shaw and updated as “access granted” in the data-base. A second follow-up letter will be sent to property owners who have not responded and USEPA may elect to in person discuss access with non-responsive owners/occupants. To aid in this process EPA will utilize bilingual staff for these communications. Shaw does not anticipate involvement in the access granting process.

Once on site, Shaw staff will attempt to systematically access and sample the designated properties for which access has been granted. As a courtesy, Shaw will notify the occupants by phone, if available a few days before sampling and adjust the planned access date if requested. Shaw personnel will also, as a courtesy knock on the door upon arrival and inform the occupants of their presence. Shaw will also attempt to provide at least one bilingual staff member for direct resident contact. At the end of the sampling effort, a card/sheet will be left on the property door indicating that the sampling has been completed, when the occupant should expect to hear about the results and who to contact with questions/concerns. This form will be drafted by EPA.

14.2 Utility Clearance

For planned remediation properties, Shaw will follow its policy, included in the HASP, for underground utility location/avoidance including prior notification to the State of Colorado utility search locator. Care will also be taken to remove and if necessary replace any resident sprinkler or lighting systems located within the removal zone. As part of the CQM process a property pre-remediation checklist will be completed to document these and other items. A similar form will be used to document completion of the removal and restoration of the property to the agreed upon specifications. Consult the Construction Quality Management Plan for these forms and further details.

Should EPA determine the need to conduct investigation sampling at additional properties and gain access, the planned pre-investigation sampling depth (0-2 inches) is not sufficient to require a formal utility survey and Shaw does not anticipate any need to contact the utility survey hot-line for any additional property investigations. During sampling activities, Shaw will use care to avoid owner/occupant installed systems such as irrigation hoses and landscape lighting conduit, where present.

14.3 Property Investigation Sampling Process

The process at each property identified for sampling is a multi-step procedure developed during the 1999 planning process and adjusted as the project progressed. This process involves; measurement of the property dimensions, identification and measurement of the separate “accessible” surface areas, identification of distinct gardens/flower-beds for separate sampling, determination of the spacing of sample locations within the accessible non-garden/bed areas, selection and distribution of sample locations, and collection of the defined composite samples.

14.3.1 Property Measurement and Sample Location Layout

All sample locations and the composite assignments are to be clearly documented on the Property Layout/Sampling Design Form, provided in SOP, ISSI-VBI70-02, amended by Shaw 2012. This form provides a template for all site measurements, a means to easily on a grid mark locations, and the composite sample assignments and designs. The basic steps involved with layout of the grab sample locations are:

- Measure and plot the overall property dimensions.
- Measure and plot all permanent structures; home, sheds, garages, paved/concrete surfaces, in ground and installed above ground pools; small kiddie pools, outdoor furniture, and picnic tables are not considered permanent structures.

- Measure and plot trees, and large shrubs, including any mulched surrounds. Do the same for flower beds and vegetable gardens.
- Evaluate the property and divide the accessible area into zones defined by breaks such as permanent structures.
 - Exclude trees/shrubs marked on the map.
 - Exclude gardens and flower beds; these will be sampled separately.
 - The goal is to define the surfaces that would be accessible to children, the primary receptors. Therefore, only define areas where a child would potentially play. As an example, some properties have thin (<2ft) strips of ground separating them from adjoining structures. It is unlikely that a child would spend any considerable time in these divider strips and sample locations should not be distributed here.
- Calculate, based on the 3ft grid, the total area of accessible and non-garden/flower bed area. Document the figure and its divisor by 30 on the form. This will be the sample spacing interval.
- Calculate the total accessible area in each defined zone and document on the form.
- Divide each zone area by the total area to get a “percentage of 30” allotted to each zone.
- Determine the number of sample locations for each zone by multiplying the percentage of 30 by 30; round to get at least 2 locations per area. Document the allotted samples per zone on the form.
- Next proceed to mark each sample location within the accessible zones
 - Each sample should be spaced as equally as possible at the calculated spacing apart.
 - Alternate colored flags as locations are marked so as not to cluster flags of the same color together.
 - Move any locations where the measured location is inaccessible, such as under a kiddie pool, to the nearest point. *Do not move/disturb the occupants’ possessions.*
- If present, select and mark locations in the flower bed/gardens and on the form
 - Select 5 locations within each distinct flower bed or garden area.
 - Do not disturb plantings and place flags away from roots so that sample collection will not damage them. Also, be mindful of irrigation/sprinkler systems/lines and connected landscape lighting wires.
 - A vegetable garden is a distinct area.

- Multiple closely spaced beds within the same zone can be considered as one bed. As an example, if a property has a front entry area planted almost entirely as an ornamental bed separated by a walkway it can be treated as one distinct bed.
- The sampling teams will not proceed with sample collection until the Project Chemist or designee has reviewed and approved the property sample design by signing off on the form. They will clearly mark any moved locations on the form.

14.3.2 Collection of Property Composites

The composites are created by collecting each assigned grab sample and placing the soil directly into the designated composite zip bag.

- Use a dedicated sample corer/bulb planter to collect each separate composite.
- The grabs for the three composites may be collected within a zone at the same time. However, the zip bags must be pre-marked, sampling implements kept separate, and sample gloves changed between grabs assigned to different composites.
- As each marked grab location is accessed;
 - Make sure any rocks, sticks or foreign materials are removed.
 - Place the corer/bulb-planter onto the surface vertically.
 - Using a twisting and pushing motion advance the tool to a depth of 2-3 inches into the soil, accounting for any sod depth.
 - Withdraw the sampler and use a spoon or spatula to remove and discard any soil below 2-inches from the sod layer, if present.
 - Push the plug out and place the top 2-inches, after any sod, directly into the labeled zip bag the grab is assigned to.
 - Backfill the hole and replace any sod plug; this can be performed by another team member or as a follow-up task before leaving the property.
 - Repeat for all grabs making sure to place each grab into its assigned zip bag.
- When finished close each zip bag, shake the soil to mix and then fill a labeled 8-oz CWM jar for each distinct composite placing it into a sample cooler. Place the zip bags and remaining material into a labeled 1-gallon zip bag for the property.
- Before leaving the property make sure all holes are plugged and any sod placed back into the tops and remove all flags, decontaminating each with a wetted cloth or wipe and that no trash has been left.
- Sign-off on the completed form.

- Leave the “Sampling Completed” card on the front door and exit the property being sure to secure any gates as you found them.

14.3.3 Analysis at CLP Off-site Laboratories

All composites will be submitted to a CLP laboratory for analysis of arsenic and lead using ICP. The three property composite values will be used to determine the UCL-95 concentrations for comparison to the site action-levels. Flower bed/garden results will be directly compared to the action-levels. However, it is anticipated that impacted flower bed/gardens will only be found on properties with UCL-95 values above action-levels.

14.3.4 Entry of Data/Results to Project Data-base

Shaw will be provided access to the EPA property data-base and UCL-95 calculation software. This system is Microsoft Access™ based and is used to document and track the status, progress, results, and decision for all of the site properties. Shaw will manage and enter the data in accordance with the procedure provided in the 1999 planning document, with any modifications necessary to accommodate the current version of Access™. Those properties for which a “remediate” decision is reached (UCL-95 >action-levels), will be added to the “need cleanup” list. Shaw will also update the data-base as properties are remediated.

14.4 Lead Based Paint (LBP) Survey

In order to protect against possible recontamination and address another potential exposure pathway, all properties deemed for cleanup built prior to 1978 will be tagged for an exterior lead-based paint (LBP) evaluation, prior to removal activities, planned for 2013. The exterior LBP survey will be performed by a subcontractor using personnel certified to conduct LBP surveys in the State of Colorado. If the subcontractor elects to utilize an XRF it will be set-up for LBP analysis/reporting and the operator will be trained and certified in its use per State of Colorado requirements. All procedures utilized and testing methods will comply with State of Colorado requirements for LBP. Properties where an exterior LBP issue exists will be identified for EPA and if directed, remediated by a certified LBP removal subcontractor prior to soil removal. Any samples collected by the subcontractor that require analysis will be analyzed by a laboratory certified for LBP analysis by the State of Colorado. A separate LBP Assessment and Abatement work plan will be developed by the subcontractor and should be referenced for further detail.

14.5 Adequacy Testing of Backfill/Restoration Materials

All materials used to fill/restore properties will be tested to ensure that they themselves do not introduce risk from chemical contaminants to residents. Grab samples will be collected on a per source or 5,000cy basis. All materials including, fill, gravel, decorative/landscaping stone, and mulch will be tested for the site COPCs (Arsenic and Lead).

Topsoil only will also be tested for the current TCL list of organics (VOCs, SVOCs, Pesticides, and Herbicides), the TAL list of metals and hexavalent chromium. The results will be compared the current (November 2012) EPA RSLs for residential direct contact. Topsoil VOC parameters will be sampled to maintain VOC integrity by using a VOC plug sampler to collect approximately 5-grams into an empty pre-weighed VOC vial. Topsoil samples will also be analyzed for agricultural properties based upon the SOW specifications.

All non-agricultural analysis, except hexavalent chromium, will be completed by a CLP laboratory with herbicide analysis being ordered as a modification. Agricultural properties and hexavalent chromium, will be determined by the Soil Water and Plant Testing Laboratory at Colorado State University.

14.6 Waste Management and Disposal

During the removal action portion of the project, the excavated soils will require timely transport and disposal and there will be no long-term storage area to stockpile available. The previous removal efforts have demonstrated that the soils removed from throughout the site have been non-RCRA hazardous and fit well within a single profile. Thus, in order to provide for real time load-out of removed soils, sets of twenty properties or less will be pre-characterized via in-place sampling of a 4-property sub-set before removal actions commence.

For each group of twenty properties set for remediation four will be randomly selected. Each of the four selected properties will be divided into quarters for sampling. A 0-12-inch grab will be collected from the approximate center of each quadrant and mixed into a property composite. If TCLP/VOCs are required for the profile, then a VOC plug sampler will be used to collect 4-5-gram VOC plugs from each quadrant with each being placed into its own empty pre-weighed VOC vial (per SW-5035A). all of the vials for a property will be placed into a single labeled zip bag and marked as one “sample”. This will provide the laboratory with a 20-25gram “sample” for ZHE preparation. In this way, VOC integrity is maintained.

The four property composites will be composited into one sample for all non-VOC analysis. Each property VOC-vial set will be analyzed as a TCLP/VOC composite.

Liquid IDW, including decontamination water is expected to be either drummed or stored in small tanks. For disposal samples will be collected using either drum thieves or bailers depending upon the storage units. The Contract Regulatory Specialist will specify sampling frequency and any potential composite designs. Any samples collected for VOCs or TCLP VOCs will be grabs to preserve VOC integrity.

Waste-profile requirements are expected to include TCLP/Metals and may also include one or more of; TCLP/VOCs, TCLP/SVOCs, TCLP/Pesticides, TCLP/Herbicides, PCBs, and total metals. The actual parameters required will be facility dependent. All analyses will be performed via a CLP laboratory with any required TCLP performed as a special request. If the facility requires the use of a State of Colorado certified laboratory, the CLP analytical request will specify this fact and the awarded laboratory's certification will be verified by the Program Chemist. The limited volume of IDW anticipated from any additional property investigation sampling will be added to excavated soil loads and will not require separate profiling. Further details can be found in the Waste Management Plan, which is included as Appendix B to this document.

14.7 Data Validation and Management

Samples collected during implementation of the sampling effort will be analyzed using approved EPA SW-846 Update III Methods in accordance with the Quality System Manual for Environmental Laboratories, version 4.2 (DoD, 2010) and the CLP SOWs listed in UFP-QAPP worksheet #19. Reporting limits for the various analytes are appropriate for comparing data against the decision criteria.

Sample data will be validated by Shaw using the U.S. Environmental Protection Agency's (EPA) *National Functional Guidelines for Superfund Inorganic Data Review* (EPA, 2010), and *National Functional Guidelines for Superfund Organic Data Review* (EPA, 2008) for guidance. Specific QC criteria identified in this QAPP, analytical methods, and laboratory SOPs will be applied to all sample results. For those analytical methods not addressed by the validation guidelines, such as some of the agricultural parameters, the evaluation is based on the published method requirements, laboratory-specific SOPs, and technical judgment following the logic of the CLP validation guidelines for data qualification.

14.7.1 Hard Copy Deliverables

All relevant raw data and documentation, including (but not limited to) logbooks, data sheets, electronic files, and final reports, will be maintained for at least 10 years, longer if directed by USACE/EPA. The CLP laboratories will be required to notify EPA 30 days before disposal of any relevant laboratory records. In addition, Shaw will maintain laboratory data packages for ten years and copies will be provided to USACE and EPA in the project final report for their retention. Shaw will maintain copies of all COC/TRs and will include copies in an appendix to the final report. The data deliverable requirements for this project will be 100 percent USEPA Level IV for all property and flower bed/garden composites and Level II deliverable for any IDW disposal profile analysis. Data reports will include sampling date, LOQ, LOD, DL, moisture content, dilution factors, as well as sample identification, test results, and laboratory flags or qualifiers as well as other information. Sample results will be reported on a dry weight basis and will be adjusted based on moisture content, amount of sample used for extraction and analysis, and dilution factor.

14.7.2 Electronic Deliverables

The CLP laboratories will provide analytical results in Staged Electronic Data Deliverable / Automated Data Review format electronic data deliverables (EDD) or the authorized CLP EDD. Laboratories will review EDDs to ensure that results in the EDDs agree with the results in the hardcopy data packages and will correct errors before EDDs are submitted to the EPA Region 8 CLP Coordinator for submittal to Shaw. Field information (e.g., sample collection date and time, sample identification) will be entered directly into the Access database from the COC form and completed sample collection forms.

14.7.3 Data Management

This section describes the data management procedures for data review, verification, reporting, and validation.

14.7.3.1 Data Reduction, Verification, and Reporting

All analytical data generated by the laboratory projects will be reviewed prior to reporting to assure the validity of reported data. This internal laboratory data review process will consist of data reduction, three levels of documented review, and reporting. Review processes will be documented using appropriate checklist forms, or logbooks, that will be signed and dated by the reviewer.

14.7.3.2 Data Reduction

Data reduction involves the mathematical or statistical calculations used by the laboratory to convert raw data to the reported data. The laboratory will perform reduction of analytical data as specified in each of the appropriate analytical methods and laboratory SOPs. For each method, all raw data results will be recorded using method-specific forms or a standardized output from each of the various instruments.

All data calculations will be verified and initialed by personnel both generating and approving them. All raw and electronic data, notebook references, supporting documentation, and correspondence will be assembled, packaged, and stored for a minimum of 10 years for future use. All reports will be held client confidential. If the laboratory is unable to store project-related data for 10 years, then it is the responsibility of the laboratory to contact Shaw to make alternative arrangements.

14.7.3.3 Laboratory Data Verification and Review

The laboratory analyst who generates the analytical data will have the primary responsibility for the correctness and completeness of data. Each step of this verification and review process will involve the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of data is essential in ensuring that data of known quality are generated consistently. All data generated and reduced will follow well-documented in-house protocols.

Level 1 – Technical (Peer) Data Review

Analysts will review the quality of their work based on an established set of guidelines, including the QC criteria established in each method, in this SAP/QAPP, and as stated within the laboratory QA Manual. This review will, at a minimum, ensure that the following conditions have been met:

- Sample preparation information is correct and complete;
- Analysis information is correct and complete;
- Appropriate SOPs have been followed;
- Calculations are verified;
- There are no data transposition errors;
- Analytical results are correct and complete;
- QC samples are within established control limits;
- Blanks and laboratory control samples (LCSs) are within appropriate QC limits;
- Special sample preparation and analytical requirements have been met;

- Manual integration is performed and documented; and
- Sample preparation logs and instrument run logs are included.

Documentation is complete, for example, any anomalies and holding times have been documented and forms have been completed.

Level 2 –Technical Data Review

A supervisor or data review specialist whose function is to provide an independent review of data packages will perform this review. This review will also be conducted according to an established set of guidelines and will be structured to verify the following findings of Level 1 data review:

- All appropriate laboratory SOPs have been followed;
- Calibration data are scientifically sound, appropriate to the method, and completely documented;
- QC samples are within established guidelines;
- Qualitative identification of contaminants is correct;
- Manual integrations are justified, properly documented, and approved;
- Quantitative results and calculations are correct;
- Data are qualified correctly
- Project specific SAP/QAPP requirements are met;
- Sample re-extraction and re-analysis are documented and reviewed;
- Documentation is complete, for example, any anomalies and holding times have been documented and appropriate forms have been completed;
- Data package's specific case narrative is complete and anomalies such as missed holding time, surrogate, LCS, matrix spike/matrix spike duplicate (MS/MSD) recovery outliers, calibration outliers, and reporting limit exceedances have been discussed;
- Level IV data packages are clearly identified in the laboratory coversheet, and instrument raw data, chromatograms, instrument performance data for all applicable methods are included in addition to the Level III QC elements;
- Data are ready for incorporation into the final report; and
- The data package is complete and complies with contract requirements.

The Level 2 review will be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from at least 10 percent of the samples are checked back to the sample preparation and analytical bench sheets. If no problems are found with the data package, the review will be considered complete.

If any problems are found with the data package, an additional 10 percent of the sample results will be checked back to the sample preparatory and analytical bench sheets. This cycle will then be repeated either until no errors are found in the checked data set or until all data has been checked. All errors and corrections noted will be documented.

Level 3 – Administrative Quality Assurance Data Review

The Laboratory QA Manager will review 10 percent of all data packages. This review should be similar to the review as provided in Level 2, except that it will provide a total overview of the data package to ensure its consistency and compliance with project requirements. All errors noted will be corrected and documented.

14.7.3.4 Data Verification

The CLP laboratory will provide the data in electronic format to the EPA CLP Coordinator who will forward it to the Shaw Program Chemist. The Shaw Program Chemist will evaluate the QC report generated by the automated EDD NFG quality check software and the EPA QC Report submitted with the data as part of the CLP deliverable. If no issues are found, the Shaw Program Chemist will perform a brief verification review of the data to cross-check received data against submitted samples, general QC, and reasonableness of results, and then provide the data to the Project Chemist for UCL-95 evaluation and inclusion in the EPA property data-base. Results for any samples for which the CLP QC validator and/or report indicate a qualification which effects usability will be held-back until the full Level IV data package is received for validation. No results will be provided to residents until the associated data package has been validated, per section 14.8.3.5.

14.7.3.5 Data Validation

CLP laboratories provide Level IV data packages on a standard turn-around time clock which provides for significant gaps between delivery of electronic data and the package. The data verification step allows for the use of data in the property evaluations without waiting for the Level IV report. The data validation process will be the means by which the decision to use the electronic data is justified and release of results to the resident/property owner is allowed. The Shaw Program Chemist will perform a 10-percent validation of the Level IV data package for associated with each sample set/file/package. For each data package the 10-percent samples selected will include any for which the CLP QC validator identified issues. The data review and validation will be performed using the following validation guidance:

- This SAP/QAPP;
- DoD QSM, version 4.2, October 25, 2010;
- Test Methods for Evaluating Solids Waste, SW846 Physical/Chemical Methods (1986 and updates);
- USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Superfund Data review (January, 2010); and
- USEPA Contract Laboratory Program, National Functional Guidelines for Organic Methods Superfund Data review (June, 2008).

Data will be validated and flagged with the following data qualifiers:

- *J+ qualifier* denotes the analyte was positively identified, but the associated numerical value is estimated with a potential high bias.
- *J- qualifier* denotes the analyte was positively identified, but the associated numerical value is estimated with a potential low bias.
- *U qualifier* denotes the analyte was analyzed for, but not detected.
- *UU qualifier* denotes that the analyte was not detected above the reported sample limit of quantitation (LOQ). However, the reported LOQ is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
- *R qualifier* denotes the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

Instead of a checklist, the data validation will be completed in a narrative memo format, modeled from the example/template provided in the Shaw SOP for Data Usability Review, provided in Attachment 2. If there are usability issues discovered in the 10-percent review for a package, the entire package will be reviewed. The data usability memo will clearly communicate/list any quality issues or qualifications which affect the use of individual data points and the Project Chemist will be notified by e-mail that data is questionable so that USACE and/or EPA can be consulted for direction as to re-sampling or other solutions. No data will be released to residents/owners until validation and acceptance of the associated Level IV deliverable has been completed.

The Project Chemist will also review all non-CLP data packages for usability. Although these data packages will be Level 2 in scope, they will be evaluated for certification of calibration requirements within Case Narratives and QC verified as the deliverable requirements include QC Summary data. Any data for waste-characterization, LBP assessment, or fill viability that does not meet minimum quality standards will not be used in project decisions.

14.8 Inspections of Field Activities

Inspections are performed on materials or services to determine compliance with contractual, planning, and other requirements. Inspection criteria are established prior to the inspection and are based upon project specifications, requirements, code specifications, and product acceptability. Acceptance criteria shall be adequate for the activity and be verified during inspection activities. Inspection may be performed and verified through visual observation, measurement of materials or equipment, examination of documentation/certification, evaluation of performance, or testing.

Inspections may be performed using the three-phase inspection method. The preparatory inspections are performed prior to startup and will examine training, procedures, equipment and materials, work plans and documents, and overall readiness to perform work. Participants in the preparatory inspection meeting include, but are not limited to, the task subcontractor, the project CQCSM, the regulatory representative, and the project health and safety representative. Initial inspections, which are performed when work begins on a particular feature of work, include an examination of the quality of workmanship and a review of control testing for compliance with contract and work plan requirements. Follow-up inspections are performed to verify compliance with procedures. Follow-up inspections will ensure a

continuation of quality and safety standards established during preparatory and initial inspections until completion of the definable work feature.

Final follow-up inspections are conducted at the completion of each task. Participants in this inspection include, but are not limited to, the task subcontractor, the project CQCSM, the regulatory representative(s), and the project health and safety representative. The final follow-up inspection is performed to ensure that the completed feature of work meets contract requirements. Any deficiencies noted during this inspection are documented, and a determination is made as to the corrective actions necessary to mitigate the deficiency. All significant deficiencies must be corrected prior to turnover.

Records of inspections are maintained in the project files. At minimum, inspection files will include inspection reports/checklists, inspection responses, any supporting documents, as well as applicable client comments.

SAP/QAPP WORKSHEET #15 – REFERENCE LIMITS AND EVALUATION TABLE

Worksheet 15.1

Matrix: Soil

Target Metals – XRF Screen-anticipated for LBP Survey (RA-phase) only

Concentration Level: Low

Analyte	Minimum Criteria Level (mg/kg)	Minimum Criteria Level Reference	Project RL Goal (mg/kg)	Achievable Laboratory Limits	
				LOQ (mg/kg)	LOD (mg/kg)
Lead-exterior paint	1.0 mg/cm2 6.0 mg/cm2-abatement	HUD 1995, CO Regulation 19	0.5 mg/cm2	0.5mg/mc2	0.5 mg/cm2

XRF must be set-up for LBP analysis/reporting

Worksheet 15.2

Matrix: Soil, Rock, Mulch

COC Metals –)-CLP or CO certified (LBP)

Concentration Level: Low

Analyte	Minimum Criteria Level (mg/kg)	Minimum Criteria Level Reference	Project RL Goal (mg/kg)	Achievable Laboratory Limits	
				LOQ (mg/kg)	LOD (mg/kg)
Arsenic	70	1999 Planning document	5	4	2.5
Lead	400	1999 Planning document	5	1	0.5

Worksheet 15.3

Matrix: Soil or LBP chips (Lead only)

Toxic Characteristic Metals – USEPA – TCLP List (CLP or CO Certified (LBP) Laboratories)

Concentration Level: Low

Analyte	Minimum Criteria Level (mg/L)	Minimum Criteria Level Reference	Project RL Goal (mg/L)	Achievable Laboratory Limits	
				LOQ (mg/L)	LOD (mg/L)
Arsenic	5.0	40 CFR 261.24	0.5	0.050	0.005
Lead	5.0	40 CFR 261.24	0.5	0.050	0.003
Barium	100	40 CFR 261.24	10.0	1.00	0.100
Cadmium	1.0	40 CFR 261.24	0.1	0.050	0.010
Chromium	5.0	40 CFR 261.24	0.5	0.10	0.050
Mercury	0.2	40 CFR 261.24	0.02	0.005	0.001
Selenium	1.0	40 CFR 261.24	0.1	0.1	0.005
Silver	5.0	40 CFR 261.24	0.5	0.1	0.005

Worksheet 15.4

Matrix: Solid Waste

Toxic Characteristic VOCs – USEPA – 1311 Modified CLP SOM02.0 – Toxic Characteristic Leaching Procedure (TCLP) List (CLP Laboratories)

Concentration Level: Low

Analyte	CAS Number	Minimum Criteria Level (mg/L)	Minimum Criteria Level Reference ^a	Project RL Goal (mg/L)	Achievable Laboratory Limits	
					LOQ (mg/L)	LOD (mg/L)
1,1-Dichloroethylene	75-35-4	0.7	40 CFR 261.24	0.001	0.0005	0.0001
1,2-Dichloroethane	107-06-2	0.5	40 CFR 261.24	0.001	0.0005	0.0001
Benzene	71-43-2	0.5	40 CFR 261.24	0.001	0.0005	0.0001
Carbon tetrachloride	56-23-5	0.5	40 CFR 261.24	0.001	0.0005	0.0001
Chlorobenzene	108-90-7	100.0	40 CFR 261.24	0.001	0.0005	0.0001
Chloroform	67-66-3	6.0	40 CFR 261.24	0.001	0.0005	0.0001
Methyl ethyl ketone	78-93-3	200.0	40 CFR 261.24	0.02	0.010	0.0004
Tetrachloroethylene	127-18-4	0.7	40 CFR 261.24	0.001	0.0005	0.0001
Trichloroethylene	79-01-6	0.5	40 CFR 261.24	0.001	0.0005	0.0001
Vinyl chloride	75-01-4	0.2	40 CFR 261.24	0.001	0.0005	0.0001

^a40 CFR 261.24: Code of Federal Regulations Chapter 40, Part 261.24

mg/L = milligrams per liter

Worksheet 15.5

Matrix: Solid Waste

Toxic Characteristic SVOC – USEPA – 1311 Modified CLP SOM02.0 – TCLP List (CLP Laboratories)

Concentration Level: Low

Analyte	CAS Number	Minimum Criteria Level (mg/L)	Minimum Criteria Level Reference ^a	Project RL Goal (mg/L)	Achievable Laboratory Limits	
					LOQ (mg/L)	LOD (mg/L)
o-Cresol	95-48-7	200.0	40 CFR 261.24	0.2	0.100	0.003
m,p-Cresol	106-44-5	200.0	40 CFR 261.24	0.2	0.100	0.005
1,4-Dichlorobenzene	106-46-7	7.5	40 CFR 261.24	0.2	0.100	0.002
2,4-Dinitrotoluene	121-14-2	0.13	40 CFR 261.24	0.1	0.100	0.003
Hexachlorobenzene	118-74-1	0.13	40 CFR 261.24	0.1	0.100	0.002
Hexachlorobutadiene	87-68-3	0.5	40 CFR 261.24	0.2	0.100	0.002
Hexachloroethane	67-72-1	3.0	40 CFR 261.24	0.2	0.100	0.002
Nitrobenzene	98-95-3	2.0	40 CFR 261.24	0.2	0.100	0.002
Pentachlorophenol	87-86-5	100.0	40 CFR 261.24	0.4	0.200	0.004
Pyridine	110-86-1	5.0	40 CFR 261.24	0.2	0.100	0.004
2,4,5-Trichlorophenol	95-95-4	400.0	40 CFR 261.24	0.2	0.100	0.003
2,4,6-Trichlorophenol	88-06-2	2.0	40 CFR 261.24	0.2	0.100	0.004

^a40 CFR 261.24: Code of Federal Regulations Chapter 40, Part 261.24.

Worksheet 15.6

Matrix: Solid Waste

Toxic Characteristic Pesticides – USEPA – 1311 Modified CLP SOM02.0 – TCLP List (CLP Laboratories)

Concentration Level: Low

Analyte	CAS Number	Minimum Criteria Level (mg/L)	Minimum Criteria Level Reference ^a	Project RL Goal (mg/L)	Achievable Laboratory Limits	
					LOQ (mg/L)	LOD (mg/L)
Chlordane (as alpha and gamma)	54-74-9	0.03	40 CFR 261.24	0.015	0.0004	0.00010
Endrin	72-20-8	0.02	40 CFR 261.24	0.01	0.0008	0.00020
Heptachlor	76-44-8	0.008	40 CFR 261.24	0.004	0.0004	0.00010
Heptachlor epoxide	1024-57-3	0.008	40 CFR 261.24	0.004	0.0004	0.00010
Lindane (gamma-BHC)	58-89-9	0.4	40 CFR 261.24	0.1	0.0004	0.00010
Methoxychlor	72-43-5	10.0	40 CFR 261.24	2.0	0.004	0.0010
Toxaphene	8001-35-2	0.5	40 CFR 261.24	0.25	0.040	0.010

^a40 CFR 261.24: Code of Federal Regulations Chapter 40, Part 261.24.

Worksheet 15.7

Matrix: Solid Waste

Toxic Characteristic Herbicides – USEPA – 1311 Modified CLP SOM02.0 modification for EPA

SW-8151A – TCLP List (CLP Laboratories)

Concentration Level: Low

Analyte	CAS Number	Minimum Criteria Level (mg/L)	Minimum Criteria Level Reference ^a	Project RL Goal (mg/L)	Achievable Laboratory Limits	
					LOQ (mg/L)	LOD (mg/L)
2,4-D	94-75-7	10.0	40 CFR 261.24	2.0	0.100	0.003
2,4,5-TP (Silvex)	93-72-1	1.0	40 CFR 261.24	0.5	0.100	0.005

^a40 CFR 261.24: Code of Federal Regulations Chapter 40, Part 261.24.

Worksheet 15.8

Matrix: Solid Waste

PCBs –CLP SOM02.0 – (CLP Laboratories)

Concentration Level: Low

Analyte	CAS Number	Minimum Criteria Level (mg/kg)	Minimum Criteria Level Reference ^a	Project RL Goal (mg/kg)	Achievable Laboratory Limits	
					LOQ (mg/kg)	LOD (mg/kg)
Arochlor 1016	12674-11-2	50.0	40 CFR 761.60	10.0	0.033	0.015
Arochlor 1221	11104-28-2	50.0	40 CFR 761.60	10.0	0.033	0.015
Arochlor 1232	11141-16-5	50.0	40 CFR 761.60	10.0	0.033	0.015
Arochlor 1242	53469-21-9	50.0	40 CFR 761.60	10.0	0.033	0.015
Arochlor 1248	12672-29-6	50.0	40 CFR 761.60	10.0	0.033	0.015
Arochlor 1254	11097-69-1	50.0	40 CFR 761.60	10.0	0.033	0.015
Arochlor 1260	11096-82-5	50.0	40 CFR 761.60	10.0	0.033	0.015
Arochlor 1262	37324-23-5	50.0	40 CFR 761.60	10.0	0.033	0.015
Arochlor 1268	11100-14-4	50.0	40 CFR 761.60	10.0	0.033	0.015

^a40 CFR 761.60: Code of Federal Regulations Chapter 40, Part 761.60 "Disposal Requirements".

Worksheet 15.9
Matrix: Topsoil
Metals –CLP ISM02.0 – (CLP Laboratories)
Concentration Level: Low

Analyte	CAS No.	Minimum Criteria (mg/kg)	Minimum Criteria Reference ^a	Project RL Goal (mg/kg)	CRQL (mg/kg)
Aluminum	7429-90-5	77000.00	EPA RSL-Residential	5000	20
Antimony	7440-36-0	31.00	EPA RSL-Residential	10	6
Arsenic	7440-38-2	70.00	EPA RSL-Residential	10	1
Barium	7440-39-3	15000.00	EPA RSL-Residential	1000	20
Beryllium	7440-41-7	160.00	EPA RSL-Residential	10	0.5
Cadmium	7440-43-9	70.00	EPA RSL-Residential	10	0.5
Calcium	7440-70-2	NS	EPA RSL-Residential	1000	500
Chromium	7440-47-3	NS	EPA RSL-Residential	10	1
Cobalt	7440-48-4	23.00	EPA RSL-Residential	10	5
Copper	7440-50-8	3100.00	EPA RSL-Residential	250	2.5
Iron	7439-89-6	55000.00	EPA RSL-Residential	1000	10
Lead	7439-92-1	400.00	Site-specific	50	1
Magnesium	7439-95-4	NS	EPA RSL-Residential	1000	500
Manganese	7439-96-5	1800.00	EPA RSL-Residential	500	1.5
Nickel	7440-02-0	1500.00	EPA RSL-Residential	500	4
Potassium	7440-09-7	NS	EPA RSL-Residential	1000	500
Selenium	7782-49-2	390.00	EPA RSL-Residential	50	3.5
Silver	7440-22-4	390.00	EPA RSL-Residential	50	1
Sodium	7440-23-5	NS	EPA RSL-Residential	1000	500
Thallium	7440-28-0	NS	EPA RSL-Residential	10	2.5
Vanadium	7440-62-2	390.00	EPA RSL-Residential	50	5
Zinc	7440-66-6	23000.00	EPA RSL-Residential	1000	6
Mercury	7439-97-6	10.00	EPA RSL-Residential	1	0.1
<i>Additional Analysis-CSU Extension</i>					
Chromium-hexavalent	18540-29-9	0.29	EPA RSL-Residential	0.15	0.1

NS-None Specified

EPA RSLs from November 2012 Summary spreadsheet, available from EPA web-site

Worksheet 15.11 Matrix: Topsoil
Volatiles –CLP SOM02.0 – (CLP Laboratories)
Concentration Level: Low

Compound	CAS No.	EPA RSL Residential I (mg/kg)	Minimum Criteria Reference ^a	Project RL Goal (mg/kg)	CRQL (mg/kg)
Dichlorodifluoromethane	75-71-8	94.00	EPA RSL-Residential	0.02	0.005
Chloromethane	74-87-3	120.00	EPA RSL-Residential	0.02	0.005
Vinyl chloride	75-01-4	0.06	EPA RSL-Residential	0.02	0.005
Bromomethane	74-83-9	7.30	EPA RSL-Residential	0.02	0.005
Chloroethane	75-00-3	15000.00	EPA RSL-Residential	0.02	0.005
Trichlorofluoromethane	75-69-4	790.00	EPA RSL-Residential	0.02	0.005
1,1-Dichloroethene	75-35-4	240.00	EPA RSL-Residential	0.02	0.005
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	43000.00	EPA RSL-Residential	0.02	0.005
Acetone	67-64-1	61000.00	EPA RSL-Residential	0.02	0.01
Carbon disulfide	75-15-0	820.00	EPA RSL-Residential	0.02	0.005
Methyl acetate	79-20-9	78000.00	EPA RSL-Residential	0.02	0.005
Methylene chloride	75-09-2	56.00	EPA RSL-Residential	0.02	0.005
trans-1,2-Dichloroethene	156-60-5	150.00	EPA RSL-Residential	0.02	0.005
Methyl-tert-butyl ether	1634-04-4	43.00	EPA RSL-Residential	0.02	0.005
1,1-Dichloroethene	75-34-3	240.00	EPA RSL-Residential	0.02	0.005
cis-1,2-Dichloroethene	156-59-2	160.00	EPA RSL-Residential	0.02	0.005
2-Butanone	78-93-3	28000.00	EPA RSL-Residential	0.02	0.01
Bromochloromethane	74-97-5	160.00	EPA RSL-Residential	0.02	0.005
Chloroform	67-66-3	0.29	EPA RSL-Residential	0.02	0.005
1,1,1-Trichloroethane	71-55-6	8700.00	EPA RSL-Residential	0.02	0.005
Cyclohexane	110-82-7	7000.00	EPA RSL-Residential	0.02	0.005
Carbon Tetrachloride	56-23-5	0.61	EPA RSL-Residential	0.02	0.005
Benzene	71-43-2	1.10	EPA RSL-Residential	0.02	0.005
1,2-Dichloroethane	107-06-2	0.43	EPA RSL-Residential	0.02	0.005
1,4-Dioxane	123-91-1	4.90	EPA RSL-Residential	0.02	0.1
Trichloroethene	79-01-6	0.91	EPA RSL-Residential	0.02	0.005
Methylcyclohexane	108-87-2	NS	EPA RSL-Residential	0.02	0.005
1,2-Dichloropropane	78-87-5	0.94	EPA RSL-Residential	0.02	0.005
Bromodichloromethane	75-27-4	0.27	EPA RSL-Residential	0.02	0.005
cis-1,3-Dichloropropene	10061-01-5	1.70	EPA RSL-Residential	0.02	0.005
4-Methyl-2-pentanone	108-10-1	5300.00	EPA RSL-Residential	0.02	0.01
Toluene	108-88-3	5000.00	EPA RSL-Residential	0.02	0.005
trans-1,3-Dichloropropene	10061-02-6	1.70	EPA RSL-Residential	0.02	0.005

Compound	CAS No.	EPA RSL Residential I (mg/kg)	Minimum Criteria Reference ^a	Project RL Goal (mg/kg)	CRQL (mg/kg)
1,1,2-Trichloroethane	79-00-5	1.10	EPA RSL-Residential	0.02	0.005
Tetrachloroethene	127-18-4	22.00	EPA RSL-Residential	0.02	0.005
2-Hexanone	591-78-6	210.00	EPA RSL-Residential	0.02	0.01
Dibromochloromethane	124-48-1	0.68	EPA RSL-Residential	0.02	0.005
1,2-Dibromoethane	106-93-4	0.03	EPA RSL-Residential	0.01	0.005
Ethylbenzene	100-41-4	5.40	EPA RSL-Residential	0.02	0.005
o-Xylene	95-47-6	690.00	EPA RSL-Residential	0.02	0.005
m,p-Xylene	179601- 23-1	590.00	EPA RSL-Residential	0.02	0.005
Styrene	100-42-5	6300.00	EPA RSL-Residential	0.02	0.005
Bromoform	75-25-2	62.00	EPA RSL-Residential	0.02	0.005
Isopropylbenzene	98-82-8	NS	EPA RSL-Residential	0.02	0.005
1,1,2,2-Tetrachloroethane	79-34-5	0.56	EPA RSL-Residential	0.02	0.005
1,3-Dichlorobenzene	541-73-1	NS	EPA RSL-Residential	0.02	0.005
1,4-Dichlorobenzene	106-46-7	2.40	EPA RSL-Residential	0.02	0.005
1,2-Dichlorobenzene	95-50-1	1900.00	EPA RSL-Residential	0.02	0.005
1,2-Dibromo-3-chloropropane	96-12-8	0.01	EPA RSL-Residential	0.02	0.005
1,2,4-Trichlorobenzene	120-82-1	22.00	EPA RSL-Residential	0.02	0.005
1,2,3-Trichlorobenzene	87-61-6	49.00	EPA RSL-Residential	0.02	0.005

NS-None Specified

EPA RSLs from November 2012 Summary spreadsheet, available from EPA web-site

Worksheet 15.12 Matrix: Topsoil
Semi-volatiles –CLP SOM02.0 – (CLP Laboratories)
Concentration Level: Low-PAHs by SIM

Compound	CAS No.	EPA RSL Residential (mg/kg)	Minimum Criteria Reference ^a	Project RL Goal (mg/kg)	CRQL (mg/kg)
Benzaldehyde	100-52-7	7800.00	EPA RSL-Residential	0.2	0.17
Phenol	108-95-2	18000.00	EPA RSL-Residential	0.2	0.17
Bis(2-chloroethyl) ether	111-44-4	0.21	EPA RSL-Residential	0.2	0.17
2-Chlorophenol	95-57-8	390.00	EPA RSL-Residential	0.2	0.17
2-Methylphenol	95-48-7	3100.00	EPA RSL-Residential	0.2	0.17
2,2'-Oxybis(1-chloropropane)	108-60-1	4.60	EPA RSL-Residential	0.2	0.17
Acetophenone	98-86-2	7800.00	EPA RSL-Residential	0.2	0.17
4-Methylphenol	106-44-5	6100.00	EPA RSL-Residential	0.2	0.17
N-Nitroso-di-n propylamine	621-64-7	99.00	EPA RSL-Residential	0.2	0.17
Hexachloroethane	67-72-1	12.00	EPA RSL-Residential	0.2	0.17
Nitrobenzene	98-95-3	4.80	EPA RSL-Residential	0.2	0.17
Isophorone	78-59-1	510.00	EPA RSL-Residential	0.2	0.17
2-Nitrophenol	88-75-5	NS	EPA RSL-Residential	0.2	0.17
2,4-Dimethylphenol	105-67-9	1200.00	EPA RSL-Residential	0.2	0.17
Bis(2-chloroethoxy) methane	11-91-1	180.00	EPA RSL-Residential	0.2	0.17
2,4-Dichlorophenol	120-83-2	180.00	EPA RSL-Residential	0.2	0.17
Naphthalene	91-20-3	3.60	EPA RSL-Residential	0.2	0.0033
4-Chloroaniline	106-47-8	2.40	EPA RSL-Residential	0.2	0.17
Hexachlorobutadiene	87-68-3	6.20	EPA RSL-Residential	0.2	0.17
Caprolactam	105-60-2	31000.00	EPA RSL-Residential	0.2	0.17
4-Chloro-3-methylphenol	59-50-7	6100.00	EPA RSL-Residential	0.2	0.17
2-Methylnaphthalene	91-57-6	230.00	EPA RSL-Residential	0.2	0.0033
Hexachlorocyclopentadiene	77-47-4	370.00	EPA RSL-Residential	0.2	0.17
2,4,6-Trichlorophenol	88-06-2	44.00	EPA RSL-Residential	0.2	0.17
2,4,5-Trichlorophenol	95-95-4	6100.00	EPA RSL-Residential	0.2	0.17
1,1'-Biphenyl	92-52-4	51.00	EPA RSL-Residential	0.2	0.17
2-Chloronaphthalene	91-58-7	6300.00	EPA RSL-Residential	0.2	0.17
2-Nitroaniline	88-74-4	610.00	EPA RSL-Residential	0.2	0.33
Dimethylphthalate	131-11-3	NS	EPA RSL-Residential	0.2	0.17
2,6-Dinitrotoluene	606-20-2	61.00	EPA RSL-Residential	0.2	0.17
Acenaphthylene	208-96-8	NS	EPA RSL-Residential	0.2	0.0033
3-Nitroaniline	99-09-2	NS	EPA RSL-Residential	0.2	0.17
Acenaphthene	83-32-9	3400.00	EPA RSL-Residential	0.2	0.17
2,4-Dinitrophenol	51-28-5	120.00	EPA RSL-Residential	0.2	0.33
4-Nitrophenol	100-02-7	NS	EPA RSL-Residential	0.2	0.33

Compound	CAS No.	EPA RSL Residential (mg/kg)	Minimum Criteria Reference ^a	Project RL Goal (mg/kg)	CRQL (mg/kg)
Dibenzofuran	132-64-9	78.00	EPA RSL-Residential	0.2	0.17
2,4-Dinitrotoluene	121-14-2	1.60	EPA RSL-Residential	0.2	0.17
Diethylphthalate	84-66-2	49000.00	EPA RSL-Residential	0.2	0.17
4-Chlorophenyl-phenyl ether	7005-72-3	NS	EPA RSL-Residential	0.2	0.17
4-Nitroaniline	100-01-6	24.00	EPA RSL-Residential	0.2	0.33
4,6-Dinitro-2-methylphenol	534-52-1	4.90	EPA RSL-Residential	0.2	0.33
N-Nitrosodiphenylamine	86-30-6	99.00	EPA RSL-Residential	0.2	0.17
1,2,4,5-Tetrachlorobenzene	95-94-3	18.00	EPA RSL-Residential	0.2	0.17
4-Bromophenyl-phenylether	101-55-3	NS	EPA RSL-Residential	0.2	0.17
Hexachlorobenzene	118-74-1	0.30	EPA RSL-Residential	0.2	0.17
Atrazine	1912-24-9	2.10	EPA RSL-Residential	0.2	0.17
Pentachlorophenol	87-86-5	0.89	EPA RSL-Residential	0.2	0.33
Phenanthrene	85-01-8	NS	EPA RSL-Residential	0.2	0.0033
Anthracene	120-12-7	17000.00	EPA RSL-Residential	0.2	0.0033
Carbazole	86-74-8	NS	EPA RSL-Residential	0.2	0.17
Di-n-butylbenzylphthalate	84-74-2	6100.00	EPA RSL-Residential	0.2	0.17
Fluoranthene	206-44-0	2300.00	EPA RSL-Residential	0.2	0.0033
Pyrene	129-00-0	1700.00	EPA RSL-Residential	0.2	0.0033
Butylbenzylphthalate	85-68-7	260.00	EPA RSL-Residential	0.2	0.17
3,3'-dichlorobenzidine	91-94-1	1.10	EPA RSL-Residential	0.2	0.17
Benzo(a) anthracene	56-55-3	0.15	EPA RSL-Residential	0.005	0.0033
Chrysene	218-01-9	15.00	EPA RSL-Residential	0.2	0.0033
Bis(2-ethylhexy) phthalate	117-81-7	35.00	EPA RSL-Residential	0.2	0.17
Di-n-octylphthalate	117-84-0	730.00	EPA RSL-Residential	0.2	0.17
Benzo(b) fluoranthene	205-99-2	0.15	EPA RSL-Residential	0.005	0.0033
Benzo(k) fluoranthene	207-08-9	1.50	EPA RSL-Residential	0.2	0.0033
Benzo(a) pyrene	50-32-8	0.02	EPA RSL-Residential	0.005	0.0033
Indeno(1,2,3,-cd) pyrene	193-39-5	0.15	EPA RSL-Residential	0.005	0.0033
Dibenzo(a,h) anthracene	53-70-3	0.02	EPA RSL-Residential	0.005	0.0033
Benzo(g,h,i) perylene	191-24-2	NS	EPA RSL-Residential	0.2	0.0033
2,3,4,6-Tetrachlorophenol	58-90-2	1800.00	EPA RSL-Residential	0.2	0.17

NS-None Specified

EPA RSLs from November 2012 Summary spreadsheet, available from EPA web-site

Worksheet 15.13 Matrix: Topsoil
Pesticides/PCBs –CLP SOM02.0 – (CLP Laboratories)
Concentration Level: Low

Compound	CAS No.	EPA RSL Residential (mg/kg)	Minimum Criteria Reference ^a	Project RL Goal (mg/kg)	CRQL (mg/kg)
alpha-BHC	319-84-6	0.08	EPA RSL-Residential	0.005	0.0017
beta-BHC	319-85-7	0.27	EPA RSL-Residential	0.005	0.0017
delta-BHC	319-86-8	0.27	EPA RSL-Residential	0.005	0.0017
gamma-BHC (Lindane)	58-89-9	0.52	EPA RSL-Residential	0.005	0.0017
Heptachlor	76-44-8	0.11	EPA RSL-Residential	0.005	0.0017
Aldrin	309-00-2	0.03	EPA RSL-Residential	0.005	0.0017
Heptachlor epoxide	1024-57-3	0.05	EPA RSL-Residential	0.005	0.0017
Endosulfan I	959-98-8	370.00	EPA RSL-Residential	0.005	0.0017
Dieldrin	60-57-1	0.03	EPA RSL-Residential	0.005	0.0033
4,4'-DDE	72-55-9	1.40	EPA RSL-Residential	0.005	0.0033
Endrin	72-20-8	18.00	EPA RSL-Residential	0.005	0.0033
Endosulfan II	33213-65-9	370.00	EPA RSL-Residential	0.005	0.0033
4,4'-DDD	72-54-8	2.00	EPA RSL-Residential	0.005	0.0033
Endosulfan sulfate	1031-07-8	370.00	EPA RSL-Residential	0.005	0.0033
4,4'-DDT	50-29-3	1.70	EPA RSL-Residential	0.005	0.0033
Methoxychlor	72-43-5	310.00	EPA RSL-Residential	10	0.017
Endrin ketone	53494-70-5	NS	EPA RSL-Residential	0.005	0.0033
Endrin aldehyde	7421-93-4	NS	EPA RSL-Residential	0.005	0.0033
alpha-Chlordane	5103-71-9	1.60	EPA RSL-Residential	0.005	0.0017
gamma-Chlordane	5103-74-2	1.60	EPA RSL-Residential	0.005	0.0017
Toxaphene	8001-35-2	0.44	EPA RSL-Residential	0.2	0.17
Aroclor-1016	12674-11-2	3.90	EPA RSL-Residential	0.005	0.033
Aroclor-1221	11104-28-2	0.14	EPA RSL-Residential	0.05	0.033
Aroclor-1232	11141-16-5	0.14	EPA RSL-Residential	0.05	0.033
Aroclor-1242	53469-21-9	0.22	EPA RSL-Residential	0.05	0.033
Aroclor-1248	12672-29-6	0.22	EPA RSL-Residential	0.05	0.033
Aroclor-1254	11097-69-1	0.22	EPA RSL-Residential	0.05	0.033
Aroclor-1260	11096-82-5	0.22	EPA RSL-Residential	0.05	0.033
Aroclor-1262	37324-23-5	0.22	EPA RSL-Residential	0.05	0.033
Aroclor-1268	11100-14-4	0.22	EPA RSL-Residential	0.05	0.033

NS=None Specified

EPA RSLs from November 2012 Summary spreadsheet, available from EPA web-site

Worksheet 15.14 Matrix: Topsoil
Herbicides –Modification EPA SW-8151A CLP SOM02.0 – (CLP
Laboratories)
Concentration Level: Low

Compound	CAS No.	EPA RSL Residential (mg/kg)	Minimum Criteria Reference ^a	Project RL Goal (mg/kg)	CRQL (mg/kg)
2,4-D	94-75-7	690.00	EPA RSL-Residential	10	5
2,4,5-T	93-76-5	610.00	EPA RSL-Residential	10	5
2,4,5-TP	93-72-1	490.00	EPA RSL-Residential	10	5
Dalapon	75-99-0	1800.00	EPA RSL-Residential	10	5
Dicamba	1918-00-9	1800.00	EPA RSL-Residential	10	5
Dinoseb	88-85-7	61.00	EPA RSL-Residential	10	5
MCPA	94-74-6	31.00	EPA RSL-Residential	10	5
MCPP	93-65-2	61.00	EPA RSL-Residential	10	5

EPA RSLs from November 2012 Summary spreadsheet, available from EPA web-site

SAP/QAPP WORKSHEET #16 – PROJECT SCHEDULE / TIMELINE TABLE-QUALITY TASKS

Activity(ies)	Responsible Organization/Party	Frequency	Deliverable/Due Date
Work Plan/SAP-UFP-QAPP Preparation	Shaw	One time with comment revisions	Work Plan-6/22/2012
Access permission letters to property owners/residents	EPA	Once with on-time follow-up to non-responders	in process-owners/residents have until mid-July 2012 to respond
Property owner/resident contact-set-up sampling	Shaw	Each property as needed	Expect to start set-up of sampling 8/1/2012
Sample properties	Shaw-Project Chemist Shaw Field Teams	Each property	Property Sample Sheets, data files, data-base entries-expected start 8/1/2012
Analysis for Arsenic and Lead CLP SOW Standard CLP SOW turn-around time unless directed by EPA	Shaw-Project Chemist Shaw Program Chemist CLP laboratory	Samples from each property submitted	CLP results, Excel file
Entry of property results and data into data-base	Shaw	As property results are received and QC cleared	Evaluation and data-base entry to be completed 3-business days after CLP data receipt for each
Reporting of results to resident/owner	EPA- Shaw if directed	Each property sampled	14-days after validation of CLP Level IV deliverable package
Conduct exterior LBP Survey of properties identified for remediation constructed prior to 1978	Shaw LBP subcontractor	Each property requiring removal action built before 1978	Assessment report including any off-site analytical due to Shaw 14 business days after sampling
Data validation of any LBP assessments including off-site analysis	Shaw-Project Chemist Shaw Program Chemist	Each report-could contain multiple properties	Validation Report, 7 business days after receipt
Collect in-place disposal sample from removal action properties	Shaw-Project Chemist Shaw Field Teams	Composite plus VOC soil plugs per 20 properties	Log book, log sheets, COC, shipping documents
Analysis for TCLP/Metals and any other facility required parameters may include PCBs, TCLP/VOC, TCLP/SVOC, TCLP/Pesticides, and TCLP/Herbicides via CLP SOW	Shaw-Project Chemist Shaw Program Chemist CLP laboratory	Samples as submitted-assumed to be a one-time event	CLP results, Excel file, Posted to CLP portal within 14 business days of sample receipt
Collect fill, topsoil, and cover material samples for pre-approval	Shaw-Project Chemist Shaw Program Chemist CLP laboratory CSU Testing Laboratory	Each 5000cy or source	Log book, log sheets, COC, shipping documents

Activity(ies)	Responsible Organization/Party	Frequency	Deliverable/Due Date
Analysis for Arsenic and Lead, via CLP SOW Topsoil only-metals, volatiles, semi-volatiles, low-concentration PAHs, Pesticides/PCBs, and herbicides via CLP SOW Hexavalent chromium and agricultural parameters via CSU Extension procedures	Shaw-Project Chemist Shaw Program Chemist CLP laboratory CSU Testing Laboratory	Each sample set, assumed to be a one time event per source or fill/material type	CLP results, Excel file, Posted to CLP portal within 14 business days of sample receipt CSU Extension Laboratory report and Excel within 14 business days of sample receipt
Collect IDW liquid sample	Shaw-Project Chemist Shaw Field Teams	Composite per volume specified by CRS	Log book, log sheets, COC, shipping documents
Analysis for TCLP/Metals and any other facility required parameters may include PCBs, TCLP/VOC, TCLP/SVOC, TCLP/Pesticides, and TCLP/Herbicides, Oil and Grease via CLP SOW	Shaw-Project Chemist Shaw Program Chemist CLP laboratory	Samples as submitted-assumed to be a one-time event	CLP results, Excel file, Posted to CLP portal within 14 business days of sample receipt
Data validation of all off-site analysis reports	Shaw-Project Chemist Shaw Program Chemist	Each report	Validation Report, 7 business days after receipt
Develop IDW disposal profiles	Shaw-Waste Management Specialist	One time	Waste Profile/Manifest
QC of data-base prior to delivery to USACE/EPA	Shaw-Project Chemist and Program Chemist	One time	Memo/checklist of correctness or list of errors requiring correction- 7 days after final entry, corrections within 3-days
Data, Compilation, Validation and Review	Shaw- Chemist or designee	Per data package	Entry into results database/spreadsheet DUR
Draft Final Report Preparation	Shaw	One time	60 days after completion of investigation task or as directed by USACE/EPA
Final Report Preparation	Shaw	One time	30 days after comment receipt

SAP/QAPP WORKSHEET #17 – SAMPLING DESIGN AND RATIONALE

Sampling designs and rationales were determined and discussed in the referenced 1999 planning document. The sampling design at each property provides for three 10-point composites from soils to be analyzed. The resulting data (3-results) are evaluated statistically and a UCL-95 calculated for arsenic and lead. These UCL-95 concentrations are compared to the action-levels and property specific decision is made.

Areas where gardens and/or flower beds are present are 5-point composite sampled in each defined bed/garden and the results directly compared to the action-levels if the associated property requires remediation. Additional tasks associated with the removal action task include, LBP survey sampling, in-place waste profiling of planned property removal soils and adequacy testing of fill and restoration materials.

Sample Location	Sample Media	Sample Location Rationale
Grab sample from Non-flower/bed garden portions on non-surfaced or permanent structured areas	Soil	Each grab sample location is determined by distribution of thirty (30) locations along a pattern designed to allocate points according to the percentage of each distinct "area" of accessible/non-permanently covered soil within the yard.
10-point composite sample for CLP analysis of Arsenic and Lead	Soil	The above 30 locations are chosen and marked in an alternating pattern creating three sets of 10 associated locations from similar areas. Each 10-point composite is analyzed for the target metals (As, Pb).
Grab sample from flower bed/garden	Soil	Flower bed and garden soils may be comprised of non-native materials and not contaminated. In addition, owners/residents may desire that these areas not be disturbed. In order to be able to ascertain the "action-level comparison" for each distinct bed/garden, five (5) locations will be selected to represent the full area w/o disturbing plants.

Sample Location	Sample Media	Sample Location Rationale
Composite from distinct flower bed/garden area for Arsenic and Lead-CLP analysis	Soil	The 5-grabs from each distinct garden/flower-bed are combined into a "bed/garden composite and analyzed for As/Pb. If the property UCL-95 is above action-levels, "clean" gardens/beds will not be disturbed. Owner/resident will be informed of "contaminated" beds/gardens and provided opportunity to refuse removal of impacted soils or pre-remove plants for replacement once bed/garden is remediated with yard.
Exterior Paint Surface-XRF screen-subcontractor	Paint or paint chip	Properties where a remediate decision is reached that were constructed prior to 1978, based upon records, will require a LBP survey. The LBP survey will be completed by a CO certified subcontractor using CO approved methods. XRF is the method utilized by LBP surveyors to determine the potential for LBP.
Exterior paint chips-off-site analysis for Lead and TCLP/Lead	Paint chips	As part of the LBP survey Colorado Rule 19 requires that a portion of the different chip types be analyzed via ICP for lead to QC the XRF screening. The highest lead chips/paint at a property are also analyzed for TCLP/Lead to determine potential RCRA hazardous status.
IDW-samples for profile-	Solid Water	Prior to beginning removal actions within each group of 20 properties waste characterization will be conducted on a composite created from four randomly selected properties. Each of the four properties will be subdivided into quarters with a grab collected from the center of each quarter. For TCLP/VOCs a 5-gram plug will be collected from each quarter and placed into an empty VOC vial, with each property sample consisting of 4 separate VOC plugs to be placed into the same ZHE by the laboratory. Samples will be collected from the 0-12 inch depth to represent the planned excavation depth. The four composites will be further composited into a single sample for analysis. TCLP/VOCs will be determined for each of the four selected properties so as not to compromise VOC integrity. The WMS anticipates that profiling will require TCLP/Metals and may require additional TCLP parameters and PCBs. IDW from sampling and other activities will be included in the yard soil waste-stream. IDW liquids will be sampled per 10 drums/containers.

Sample Location	Sample Media	Sample Location Rationale
Backfill/restoration material sampling	Fill, gravel/rock, landscape rock, mulch, and topsoil	Grab sample per 5000cy or source in place or stockpiled. All materials tested for arsenic and lead. Topsoil only also tested for VOCs, SVOCs including low-level PAHs, Pesticides/PCBs, metals, and herbicides and compared to EPA RSLs for residential use. Topsoil also tested for agricultural parameters per specification. Analysis for all non-agricultural properties except Cr VI via CLP. Agricultural properties of topsoil and CrVI determined by CSU Plant, Soil and Water Testing Laboratory.

SAP/QAPP WORKSHEET #18 – SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

Sampling Location	Sample ID Number	Matrix	Depth (bgs)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
Varies-10-point composites (3) per property. Plus, 5-pt composite per garden/flower bed	Assigned as collected-associated with property address Containers to CLP lab will have Scribes™ assigned IDs	Soil	0-2 inches	Arsenic and Lead via CLP SOW	Per property 3 composites plus one composite per each distinct garden/flower bed/area. Duplicates at 10%	Shaw modified SOP from 1999 planning document
Exterior paint on properties where UCL-95 is above action-levels	Assigned as collected associated with address	Paint/chips	NA	XRF screen with off-site confirmation using certified LBP laboratory/methods	Per State of CO LBP requirements-minimum of one sample per property for off-site 6010/6020	Per subcontractor State of Colorado compliant procedures
Fill/cover materials	BCK-TYPE-##	Rock, gravel, fill, mulch	NA	Arsenic and Lead via CLP SOW	Per 5000cy or source	Shaw modified SOP, Fill Materials, from 2002 PRI phase
Topsoil	BCK-Top-##	Topsoil	0-12 inches if sampled in place	Metals, Volatiles, Semi-volatiles, Low concentration (SIM)semi-volatiles, Pesticides/PCBs, and Herbicides via CLP SOW Hexavalent Chromium via EPA 7196A-modified for soil and agricultural parameters via CSU procedures	Per 5000cy or source	Shaw modified SOP, Fill Materials, PRI-2002

Sampling Location	Sample ID Number	Matrix	Depth (bgs)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference
IDW	IDW-###	IDW-solid	NA	TCLP Metals at a minimum, may also include; PCBs and TCLP for Volatiles, Semi-volatiles, Pesticides, and Herbicides	One composite per 20 properties, TCLP/VOC on soil plug grabs, ZHE composited by lab	Shaw modified SOP, Soil Sampling, PRI-2002
IDW	IDWL-##	IDW-liquid		Metals (As,Pb) may also include; TAL Metals, VOCs, SVOCs, Pesticides/PCBs, and Oil and Grease	Grab per 10 drums	Shaw modified SOP, Soil Sampling, PRI-2002

SAP/QAPP WORKSHEET #19 – ANALYTICAL SOP REQUIREMENTS TABLE

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference ²	Sample Size	Containers (number, size, and type) ^a	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis) ^b
Property Sampling						
Soil	CLP analysis for arsenic and lead	CLP SOW for Inorganics-2010-selected lab SOP	50-125 grams	(1) 8-oz CWM per sample	Cool ≤ 6°C	180 days
LBP Off-site-(LBP subcontractor selected laboratory)						
Paint chips	Lead TCLP Lead (if needed)	TCLP, SW-846 1311 Lead, SW-6010B, CO regulation 19 certified	10-125 grams	Plastic zip bag per chip type	Non required	TCLP within 14 days 6 months
IDW Disposal						
IDW	RCRA 8 Metals (may only analyze As and Pb)	CLP Inorganic SOW, selected lab SOP	2 grams	(1) 8-oz CWM jar	Cool ≤ 6°C	6 months
IDW	Mercury	CLP Inorganic SOW, selected lab SOP	2 grams	(1) 8-oz CWM jar	Cool ≤ 6°C	28 days
	TCLP	SW-846 1311, performed as modification to CLP, selected lab SOP	200 grams	(1) 16-oz CWM jar	Cool ≤ 6°C	14 days to TCLP extraction)
IDW	TCLP Metals	CLP Inorganic SOW, selected lab SOP	50ml TCLP	NA-lab	NA	Mercury 28 days Other Metals 6 months
IDW	TCLP VOC	CLP Organic SOW modified for ZHE (SW-1311), selected lab SOPs	25 grams	1 40ml VOC pre-weighed empty with 5 VOC plugs	Cool ≤ 6°C	Freeze within 48-hours, ZHE extraction in 14 days VOC analysis 14 days

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference ²	Sample Size	Containers (number, size, and type) ^a	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis) ^b
IDW Disposal						
IDW	TCLP, SVOC, Pesticides, Herbicides	CLP Organic SOW modified for TCLP, selected lab SOP	600ml TCLP	NA-performed in lab	NA	7 days (after TCLP) to extraction 40 days to analysis
IDW	PCBs	CLP Organic SOW, selected lab SOP	30 grams	(1) 8-oz CWM jar	Cool ≤ 6°C	14 days to extraction 40 days to analysis
IDW liquids	Metals including Mercury	CLP Inorganic SOW, selected lab SOP	200ml	(1)250ml HDPE pH<2 w/nitric acid	Cool ≤ 6°C	Mercury 28 days Other metals 6 months
IDW liquids	VOCs or TCLP/VOCs	CLP Organic SOW, selected lab SOP	40ml	(3) 40ml VOC vials pH<2 with HCL	Cool ≤ 6°C	14 days
IDW liquids	SVOCs, or TCLP-SVOCs	CLP Organic SOW, selected lab SOP	1000ml	(1) 32-oz CWM jar	Cool ≤ 6°C	7 days to extraction 40 days analysis
IDW liquids	Pesticides or TCLP Pesticides	CLP Organic SOW, selected lab SOP	1000ml	(1) 32-oz CWM jar	Cool ≤ 6°C	7 days to extraction 40 days analysis
IDW liquids	Herbicides or TCLP Herbicides	CLP Organic SOW, selected lab SOP	1000ml	(1) 32-oz CWM jar	Cool ≤ 6°C	7 days to extraction 40 days analysis
IDW liquids	PCBs	CLP Organic SOW, selected lab SOP	1000ml	(1) 32-oz CWM jar	Cool ≤ 6°C	7 days to extraction 40 days analysis
IDW liquids	Oil and Grease	CLP Organic SOW, modified to provide EPA 1664, selected lab SOP	1000ml	(1)32-oz CWM pH<2 with sulfuric acid	Cool ≤ 6°C	7 days to extraction 40 days analysis

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference ²	Sample Size	Containers (number, size, and type) ^a	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis) ^b
Fill and Cover Material Certification						
All materials	CLP analysis for arsenic and lead	CLP SOW for Inorganics-2010-selected lab SOP	50-125 grams	8-oz CWM per sample	None required	180 days
Topsoil	Metals	CLP SOW for Inorganics, selected lab SOP	5-10 grams	(1) 8-oz CWM jar	Cool ≤ 6°C	Mercury 28 days Other metals 6 months
Topsoil	PAHs-low level	CLP SOW for Organics, SIM modification, selected lab SOP	30-50 grams	(1) 8-oz CWM jar	Cool ≤ 6°C	14 days to extraction 40 days to analysis
Topsoil	VOCs-low level	CLP SOW for Organics, selected lab SOP	5 grams	(2) 40ml VOC pre-weighed empty with 5 VOC plugs	Cool ≤ 6°C	Freeze within 48-hours 14 days
Topsoil	SVOCs, Pesticides/PCBs, Herbicides	CLP SOW for Organics, Herbicides as a modification, selected lab SOPs	100 grams	(1) 8-oz CWM jar-same as for PAH low-level	Cool ≤ 6°C	14 days to extraction 40 days to analysis
Topsoil	Agricultural parameters (Organic content, pH, N/P,) plus Hexavalent chromium	CSU Soil, Water and Plant Testing Laboratory procedures	1-gallon	(1) 8-oz CWM jar (CrVI) (1) 1-gallon zip bag	Cool ≤ 6°C	Cr(VI)-7 days All others 28 days

SAP/QAPP WORKSHEET #20 – FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

Matrix	Analytical Group	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of MS/MSDs	No. of Trip Blanks	No. of Field Blanks	No. of QA Split Samples	Total No. of Field Samples to Lab
Property Sampling									
Soil	Arsenic and Lead via ICP	CLP SOW for Inorganics-2012, selected lab SOP	minimum of 3 (10-pt) composite per property plus 5-pt composite per distinct flower bed/garden	10% minimum of one per sampling week per team	One per batch of 20	NA	One per day per sampling team	NA	TBD
IDW Disposal									
IDW-Soil	TCLP for Metals, SVOCs, VOCs, Pesticides, Herbicides, PCBs	CLP SOW-lab SOP	One composite from four properties per 20 properties remediated. TCLP-VOC one (4-plugs) sample per selected property	0-one time event anticipated	0-site-specific not required	NA	NA	0	One-composite plus four for TCLP-VOC-lab composite into ZHE
IDW-liquids	Metals, VOCs, PCBs, Oil and Grease, TCLP for-SVOCs, Pesticides, Herbicides,	CLP SOW-lab SOP,	TBD Composite. VOCs as grabs	0-one time event anticipated	0-site specific not required	NA	NA	0	TBD

Matrix	Analytical Group	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of MS/MSDs	No. of Trip Blanks	No. of Field Blanks	No. of QA Split Samples	Total No. of Field Samples to Lab
LBP Survey Related									
Paint Chips	Lead TCLP-Lead	LBP subcontractor off-site lab specific	Per paint type per property surveyed	10%	At least one from site	NA	NA	0	TBD
Backfill Material Certification									
All material-fill, rock, mulch	Metals-As and Pb	CLP SOW for Inorganics, selected lab specific	TBD-each source/type of material per 5000cy or less	0	No site-specific required	NA	NA	0	TBD
Topsoil	Metals VOCs-low/medium SVOCs PAHs-trace Pesticides/PCBs Herbicides	CLP SOW for Organics, modifications for PAHs(SIM) and Herbicides, selected lab specific	Each source per 5000cy or less	0	No site-specific required	NA	NA	0	TBD
Topsoil	Hexavalent Chromium Agricultural parameters	CSU-extension laboratory specific	Each source per 5000cy or less	0	No site-specific required	NA	NA	0	TBD

SAP/QAPP WORKSHEET #21 – PROJECT SAMPLING SOP REFERENCES TABLE

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP EID-FS001, and per SOP ISSI-VBI70-02, 1999	Field Logbook,, EID-FS001, Shaw, Revision 2, 8/25/2011 Residential Soil Sampling for Yards, and Schools or Park Soils, 7/29/1999, ISSI-VBI70-02, amended 2012 Shaw Bulb Planter Surface Soil Sampling, EID-FS102, Shaw, Revision 2, 8/25/2011	Shaw and ISSI	NA	N	Documents observations, sampling information, and other pertinent information on project sites.
SOP EID-FS002 and as above	Field Logsheets, EID-FS002, Shaw, Revision 2, 1/23/2012 Residential Soil Sampling for Yards, and Schools or Park Soils, 7/29/1999, ISSI-VBI70-02, amended 2012; Shaw	Shaw and ISSI	NA	N	Document single property sampling design and sample collection process.
SOP EID-FS005	Custody Seals, EID-FS005, Shaw, Revision 2, 8/25/2011	Shaw	NA	N	Includes procedure for completion and attachment of custody seals on environmental samples and shipping containers.
SOP EID-FS006	Sample Labeling, EID-FS006, Shaw, Revision 2, 8/25/2011	Shaw	NA	N	Provides requirements for completion and attachment of sample labels on environmental sample containers.
LBP subcontractor specific	LBP subcontractor specific, must comply with State of Colorado LBP requirements	Shaw LBP subcontractor	XRF	N	LBP subcontractor has not been determined at this time CO certified subcontractor will be used
MK-VBI70-04 NA	Investigative Derived Waste Management, MK, 7/15/1999 Soil Sampling, PRI 12/31/2002, amended by Shaw 6/2013	MK PRI	NA	N	Provides directive as to storage and disposal of IDW Section 4.3 provides detail for in-place pre-characterization of property soils for disposal characterization
NA	Fill Materials, PRI 12/31/2002, amended by Shaw 6/2013	PRI	NA	N	Provides detail on sampling of fill and topsoil materials prior to use

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
MK-VBI70-07	Decontamination, MK, 7/15/1999	MK	NA	N	Provides requirements for sampling implement decontamination
SOP EID-FS012	Shipping and Packaging of Non Hazardous Samples, EID-FS012, Shaw, Revision 2, 8-25-11	Shaw	Shipping Container	N	Includes sample packaging, shipping, and requirements for Non-Hazardous Samples.

SAP/QAPP WORKSHEET #22 – FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference
XRF-if used by LBP contactor	Daily Blank, Energy Calibration and LBP response checks (negative and positive reference)	Per manufacturer	Verify operation	Verify connections, no damage to window/shield	At beginning of use	XRF must meet defined specifications		LBP subcontractor	
Mini-Ram dust monitor	Daily check of performance using manufacturer supplied controls	Per manufacturer	Verify operation	Verify connections, flows, response	Each day at beginning of use	Must meet criteria	Correct issue or tag out of service and replace	Shaw or subcontractor SSO	
Personal Sampling Pump	Check or calibrate flow Verify cartridge lot	Check flow against certified source	Verify operation	Verify inlet flow and usability of filters cartridges	Each day at beginning of use	Must meet criteria	Correct issue or tag out of service and replace	Shaw or subcontractor SSO	

The Project Chemist will be responsible for ensuring that sufficient sampling supplies, zip bags, sample jars, and coolers are available.

SAP/QAPP WORKSHEET #23 – ANALYTICAL SOP REFERENCES TABLE

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
Varies by selected CLP laboratory	TCLP Metals Digestion/Preparation USEPACLP ISM02.0, November 2012	Definitive	Soil – Metals Water-Metals	Preparation	CLP laboratory selected per sample set	N
Varies by selected CLP laboratory	Mercury Analysis by Manual Cold Vapor Technique Methods, ISM02.0, November 2012	Definitive	Soil-Mercury TCLP Mercury Water-Mercury	CVAA	CLP laboratory selected per sample set	N
Varies by selected CLP laboratory	METALS BY INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY (ICP-AES) TECHNIQUE USEPA CLP, ISM02.0, November 2012	Definitive	Soil – Metals Water-Metals	ICP	CLP laboratory selected per sample set	N
Varies by selected CLP laboratory	Low/Medium Concentrations of Volatile Organic Compounds Analysis, CLP SOM02.0, April 2013	Definitive	Soil-VOCs TCLP-VOCs Water-VOCs	Closed-loop Purge and Trap GC/MS	CLP laboratory selected per sample set	N
Varies by selected CLP laboratory	Semi-volatile Organic compounds Analysis, CLP SOM02.0, April 2013	Definitive	TCLP-SVOCs Soil-SVOCs Soil-PAH-trace (SIM) Water-SVOCs	GC/MS SIM for PAH	CLP laboratory selected per sample set	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
Varies by selected CLP laboratory	Pesticides Analysis, CLP SOM02.0, April 2013	Definitive	TCLP-Pesticides Soil-Pesticides Water-Pesticides	GC-ECD	CLP laboratory selected per sample set	N
Varies by selected CLP laboratory	Herbicides analysis, (SW-8151A) as a modification to CLP SOM02.0, April 2013	Definitive	TCLP-Herbicides Soil-Herbicides Water-Herbicides	GC-ECD	CLP laboratory selected per sample set	N
Varies by selected CLP laboratory	Arochlors Analysis, CLP SOM02.0, April 2013	Definitive	Soil-PCBs Water-PCBs	GC-ECD	CLP laboratory selected per sample set	N
Varies by selected CLP laboratory	EPA 1664, Modification to CLP SOM02.0, April 2013	Definitive	Water-Oil and Grease	IR or gravimetric	CLP laboratory selected per sample set	N
CSU specific	Hexavalent Chromium, based upon SW-846 7196A	Definitive	Soil-Hexavalent chromium	Colorimetric	CSU-extension	N
CSU-specific	Agricultural parameters, (pH, nitrogen, phosphorous, iron, copper, potassium, zinc, manganese, organic content, conductivity, per CSU procedures	Definitive	Soil-agricultural parameters	Various	CSU-extension	N

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
LBP subcontractor off-site lab specific	Lead in paint chips, Colorado Regulation 19 certified based upon SW-6010C	Definitive	Paint Chips-Lead	ICP	LBP subcontractor (subcontracted off-site)	N

SAP/QAPP WORKSHEET #24 – ANALYTICAL INSTRUMENT CALIBRATION TABLE

All analytical instruments will be calibrated and the calibration acceptance criteria met before samples are analyzed. The analytical laboratories will follow calibration procedures that are compliant with the CLP SOW. Calibration standards will be prepared with National Institute for Standards and Testing-traceable standards and analyzed per methods requirements. The initial calibration will meet one of the following requirements:

- The lowest concentration of the calibration standard is less than or equal to the LOQ based on the final volume of extract or sample.
- Before samples are analyzed, initial calibration will be verified with a second source standard prepared at the midpoint of the calibration curve. Initial calibration verification will meet the acceptance criteria that are expressed in the SAP/QAPP, DoD QSM and SW846 (1996 and update).
- Daily calibration verification will be conducted at the method-prescribed frequencies, and will meet the acceptance criteria defined in the SAP/QAPP, CLP SOW, DoD QSM, and SW846 (1996 and update).
- Calibration data (calibration tables, chromatograms, instrument printouts, and laboratory logbooks) will be clearly labeled to identify the source and preparation of the calibration standard and therefore be traceable to the standard preparation records.

Worksheet #24 identifies all site-specific analytical instrumentation that requires maintenance, testing, or inspection and provides the SOP reference number for each.

SAP/QAPP Worksheet #24.1 – Analytical Instrument Calibration Table (ICP Metals)

Instrument/ Method	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CORRECTIVE ACTION	Person Responsible for CORRECTIVE ACTION	SOP Reference
Inductively- coupled Plasma (ICP)	Initial Calibration	Beginning of each day or if QC exceeds criteria	Minimum one high standard and a calibration blank.	Recalibrate and/or perform instrument maintenance	Analyst/ Supervisor	Varies-CLP lab
	Initial/Continuing Calibration	At the beginning (second source) and end of each run sequence, and after every 10 samples	ICV/CCV: 90 – 110%	Check problem, recalibrate and reanalyze all samples from last successful CCV. If %D > 110% and sample result is ND, narrate with project approval.	Analyst/ Supervisor	
Cold Vapor Atomic Absorption Spectroscopy (CVAA)	Initial Calibration	Beginning of each day or if QC exceeds criteria	Minimum 5-point initial calibration and a calibration blank Linear regression R-Squared ≥ 0.990 (R > 0.995)	Recalibrate and/or perform instrument maintenance	Analyst/ Supervisor	Varies-CLP
	Initial/Continuing Calibration	At the beginning (second source) and end of each run sequence, and after every 10 samples	ICV: 90 – 110% CCV: 80 – 120%	Check problem, recalibrate and reanalyze all samples from last successful CCV. If %D > 120% and sample result is ND, narrate with project approval.	Analyst/ Supervisor	
	Continuing Calibration	At the beginning and end of the sequence and every 10 field samples or every 5 samples if analyzing in quadruplicate	ICV 10% difference CCV 15% difference	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	
pH	Calibration	Before analysis then check every 3 hours	4 \pm .05 pH units, 7 \pm .05 pH units, pH 10 \pm 0.10 pH units, \pm 0.20 pH units for check	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	Varies-CLP

All laboratory services are off site. The documentation required for calibrations and instrument checks, as well as information on how calibrations are traced back to specific instruments for each analytical parameter, resides in the method-specific SOPs maintained by the labs (which are CLP-certified) and in the laboratory's QA manuals.

SAP/QAPP Worksheet #24.2 – Analytical Instrument Calibration Table (Cold Vapor Atomic Absorption)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
CVAA	Initial multipoint calibration, with a minimum of five standards and one calibration blank; lowest standard at or near the RL	ICAL prior to sample analysis	Correlation coefficient > 0.995; accepted if the ICV passes	Reanalyze concentrations not meeting acceptance criteria. If necessary perform maintenance, then repeat ICAL	Lab Manager/Analyst	Selected CLP lab specific
	Second-source ICV, prepared at the calibration midpoint	Once per ICAL	Less than 10% difference from ICAL for all target analytes	Repeat ICV with fresh standard if deemed necessary. Recalibrate if ICV continues to fail	Lab Manager/Analyst	
	CCV, same source as ICAL	After every 10 samples and at the end of the sequence	Less than 20% difference from ICAL for all target analytes	Perform maintenance, and then repeat daily calibration verification. If still out, recalibrate	Lab Manager/Analyst	
	Calibration blank	After ICAL, before CCV calibration, after every 10 samples, and at the end of the sequence	No target analytes \geq PQL	Re-prepare and reanalyze the blank, then recalibrate the instrument.	Lab Manager/Analyst	

SAP/QAPP Worksheet #24.3 – Analytical Instrument Calibration Table (GC/MS VOA)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS Volatile Organic Analysis (VOA) (8260C)	Check of mass spectral ion intensities (tuning procedure) using bromofluorobenzene (BFB)	Prior to initial calibration (ICAL) and calibration verification	Must meet the USEPA method requirements before samples are analyzed mass to charge ratio (m/z) required Intensity (relative abundance) mass 50-15 to 40% of m/z 95 mass 75- 30 to 60% of m/z 95 mass 95- Base peak, 100% relative abundance mass 96 -5 to 9% of m/z 95 mass 173 Less than 2% of m/z 174 mass 174 Greater than 50% of m/z 95 mass 175-5 to 9% of m/z 174 mass 176 Greater than 95% but less than 101% of m/z 174 mass 177-5 to 9% of m/z 176	If necessary, perform maintenance such as clean/change injection port, clip column, clean detector, etc. and retune instrument and verify the tune acceptability.	Lab Manager/Analyst	Selected CLP lab specific
	Five-point ICAL for target analytes, lowest standard at or near the LOQ	ICAL prior to sample analysis	The minimum average system performance check compound (SPCC) response factor (RF) is 0.1 for chloromethane, 1,1-dichloroethane, and bromoform and 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane	If necessary, perform maintenance and retune instrument and verify the tune acceptability, then repeat ICAL.	Lab Manager/Analyst	
	Second-source calibration verification	Once per five-point ICAL	Less than 20% difference for all target analytes and calibration check compounds (CCC)	First, reanalyze second source standard. If necessary, perform preventative maintenance. Then repeat ICAL.	Lab Manager/Analyst	

SAP/QAPP Worksheet #24.3 – Analytical Instrument Calibration Table (GC/MS VOA) (continued)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS VOA (continued)	Daily calibration verification	Before sample analysis and every 12 hours of analysis time	Average RFs for SPCCs ≥ 0.30 for Chlorobenzene and 1,1,2,2-trichloroethane; ≥ 0.1 for chloromethane, bromoform and 1,1-DCA $\leq 20\%$ difference/drift for all target analytes and CCCs	If necessary, perform maintenance such as clean/change injection port, clip column, clean detector, etc. Then repeat ICAL. Reanalyze samples with noncompliant bracketing continuing calibration verifications (CCVs)	Lab Manager/ Analyst	Selected CLP lab specific

SAP/QAPP Worksheet #24.4 – Analytical Instrument Calibration Table (GC/MS SVOC, and low-PAH (SIM),

Instrument	Calibration Procedure	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS (SVOC PAHs,)	Check of mass spectral ion intensities (tuning procedure) using decafluorotriphenylphosphine (DFTPP)	Prior to ICAL and calibration verification	Must meet the tuning criteria requirements before samples are analyzed Mass - Ion Abundance Criteria 51 - 10-80% of Base Peak 68 - < 2% of mass 69 70 - < 2% of mass 69 127 - 10-80% of Base Peak 197 - < 2% of mass 198 198 - Base peak, or > 50% of Mass 442 199 - 5-9% of mass 198 275 - 10-60% of Base Peak 365 - > 1% of mass 198 441 - present but < 24% of mass 442 442 - Base Peak, or > 50% of mass 198 443 - 15-24% of mass 442	Retune instrument and verify the tune acceptability.	Lab Manager/ Analyst	Selected CLP lab specific
	Minimum five-point ICAL for target analytes; lowest standard at or near the LOQ	ICAL prior to sample analysis, daily, or every 12-hours for white phosphorus	1. Average RF for SPCCs ≥ 0.050 . 2. Relative Standard Deviation (RSD) for RFs for CCCs $\leq 30\%$ and one option below: Option 1: RSD for each analyte $\leq 15\%$; Option 2: linear least squares regression $r \geq 0.995$; Option 3: nonlinear regression-coefficient of determination $r^2 \geq 0.99$ (6 points shall be used for second order; 7 points shall be used for third order).	Repeat analysis of concentration not meeting acceptance criteria. If still out of acceptance criteria perform maintenance (if necessary), obtain fresh calibration standards, then repeat ICAL.	Lab Manager/ Analyst	

SAP/QAPP Worksheet #24.4 – Analytical Instrument Calibration Table (GC/MS SVOC and low-, PAH (SIM)-continued)

Instrument	Calibration Procedure	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS (SVOC, PAH, WP) (continued)	Second-source calibration verification	Once per five-point ICAL, none existing for white phosphorus.	Less than 20% difference for target analytes	Repeat analysis Perform maintenance if necessary, then repeat ICAL.	Lab Manager/ Analyst	Selected CLP lab specific
	Daily CCV	Before sample analysis and every 12 hours, as specified by the method, none necessary for white phosphorus with ICAL daily.	1. Average RF for SPCCs: SVOCs \geq 0.050. 2. Percent Difference/Drift for all target compounds and surrogates: SVOCs \leq 20% Difference (Note: D = difference when using RFs or drift when using least squares regression or nonlinear calibration)	Repeat CCV analysis. Evaluate the system and perform maintenance if necessary, if still out then recalibrate. Reanalyze affected samples	Lab Manager/ Analyst	
	Internal Standards	During data acquisition of calibration standard,	Areas within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Lab Manager/ Analyst	

SAP/QAPP Worksheet #24.5 – Analytical Instrument Calibration Table (GC)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC Electrolytic Conductivity Detector (ECD)	Minimum five-point ICAL for target analytes, lowest concentration standard at or near the LOQ. Verification of DDT/Endrin breakdown	ICAL prior to sample analysis ICAL daily for each solvent for nitrogen, phosphorous detector (NPD)	One of the options below: Option 1: relative standard deviation (RSD) for each analyte $\leq 20\%$ (15% for NPD); Option 2: linear least squares regression: $r \geq 0.995$; Option 3: nonlinear regression: coefficient of determination $r^2 \geq 0.99$ (6 points shall be used for second order; 7 points shall be used for third order).	Repeat analysis of concentrations not meeting acceptance criteria. If necessary, perform instrument maintenance (such as clean/change injection port, clip column, clean detector, etc.), then repeat ICAL.	Lab Manager/ Analyst	CLP selected lab specific
	Second-source calibration verification.	Once per five-point ICAL	Less than 20% difference for target analytes.	If necessary, perform instrument maintenance, then repeat ICAL.	Lab Manager/ Analyst	
	Daily CCV	Before sample analysis and every 10 samples and at the end of the analysis sequence	Less than 20% difference for all target analytes.	If necessary, perform instrument maintenance, then repeat initial or daily calibration; reanalyze samples with noncompliant bracketing CCVs	Lab Manager/ Analyst	

SAP/QAPP WORKSHEET #25 – ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP-AES	Clean plasma torch; clean filters; clean spray and nebulizer chambers; replace pump tubing	Metals	Torch, filters, nebulizer chamber, pump, pump tubing	Maintenance is performed prior to initial calibration or as necessary.		Repeat maintenance activity or remove from service.	Analyst/Department Manager	CLP Lab SOP
CVAA	Change the tubing, filter, clean windows, and check gas flow. Check the reagents and standards.	Mercury	Inspect the tubing, filter, and the optical cell	Maintenance is performed prior to initial calibration or as necessary.		Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data	Analyst/Department Manager	CLP lab specific
GC/MS	Injection port Maintenance	Preventative maintenance	Change septum, clean injection port, clip column	Daily	Tune and CCV pass criteria (WS #24)	Re-inspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst/Department Manager	CLP lab specific

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS-VOC	Trap	CCV response dropping, sample foamed over	Change trap	When responses start to drop or after foam over samples	Tune and CCV passes criteria. (WS #24)	Re-bake trap, replace trap, reanalyze CCV, recalibrate	Analyst/Department Manager	CLP lab specific
GC/MS	Detector maintenance	Column change, unable to tune instrument	Clean detector, change pump oil	When responses drop and tunes start to fail	Tune passes, air and water are not present in the scan	Disassemble detector and check parts, check heating element, reanalyze tune	Analyst/Department Manager	CLP lab specific
GC	Injection port Maintenance	Preventative maintenance	Change septum, clean injection port, clip column	Daily	CCV passes criteria (WS #24)	Re-inspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst/Department Manager	CLP lab specific

The CLP laboratories will be expected to maintain sufficient spare parts necessary to maintain analytical throughput. Individual laboratory SOPs and/or Quality Management Plans will specify required parts, inventory-control processes, and responsible parties. These vary by laboratory.

SAP/QAPP WORKSHEET #26 – SAMPLE HANDLING SYSTEM

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT-off-site (CLP) Samples

Sample Collection (Personnel/Organization): Shaw Field Technician, Field Chemist; LBP subcontractor

Sample Packaging (Personnel/Organization): Shaw Field Technician, Field Chemist; LBP subcontractor

Coordination of Shipment (Personnel/Organization): Shaw Program Chemist, EPA Region 8 CLP Coordinator , Shaw Project Chemist, LBP subcontractor

Type of Shipment/Carrier UPS, or FedEx, or local delivery

SAMPLE RECEIPT AND ANALYSIS

Sample Receipt (Personnel/Organization): Project Chemist, laboratories

Sample Custody and Storage (Personnel/Organization): Project Chemist, laboratories

Sample Preparation (Personnel/Organization):, Project Chemist, CLP and other laboratories

Sample Determinative Analysis (Personnel/Organization): CLP and other laboratories

SAMPLE ARCHIVING

Field Sample Storage (Number of days from sample collection): Ship to CLP laboratory within two days of sampling possible; maintain all samples before shipment in cooler under COC. CLP laboratories are to store samples for a minimum of 60-days after final report submittal to Shaw.

Sample Extract/Digestate Storage (Number of days from extraction/digestion): See SAPP/QAPP for method requirements.

Biological Sample Storage (Number of days from sample collection): Not Applicable

SAMPLE DISPOSAL

Personnel/Organization: Field samples will be maintained until all CLP data has been received and validated. Thereafter, the samples will be drummed for disposal. CLP laboratories will dispose of samples a minimum of 60-days after submittal of the final report for each SDG received.

SAP/QAPP WORKSHEET #27 – SAMPLE CUSTODY REQUIREMENTS TABLE

27.1 Sample Custody and Documentation

Sampling information will be recorded on a COC record form and/or spreadsheet and in a permanently bound field logbook or Sample Collection Log sheet. All entries will be legible and recorded in indelible ink. Because samples will be analyzed by multiple laboratories, the terms laboratory and Sample Custodian are generic. The custody procedures described herein apply to all laboratories.

27.2 Sample Labeling

Sample labels for all CLP testing and the CSU-agricultural parameters will be completed using the EPA Scribes™ software. Any information that requires real-time completion will be filled out with indelible ink. The LBP subcontractor will utilize its own sample labels. Sample labels will be affixed to each sample container used for the property composites. Sample labels will be covered with clear tape, per USACE requirements. Samples designated for CLP laboratory shipment will be aliquoted into glass sample jars and placed in re-sealable plastic bags to protect the sample from moisture during transportation to the laboratory. Each sample container will be labeled with the following, at minimum:

- Sample identification number;
- Sample collection date (month/day/year);
- Time of collection (24-hour clock);
- Sampler's name or initials;
- Analyses to be performed; and
- Preservation (if any).

27.3 Chain of Custody

In addition to providing a custody exchange record for the samples, the COC record form serves as a formal request for sample analyses. All field samples will be shipped to a designated CLP laboratory for analysis. Composites will be collected and created in plastic zip bags and then mixed and transferred to 8-oz glass jars by the same team members for CLP shipment. The samples will be entered into the EPA Scribes™ system and the Traffic Report (TR) will be printed and saved in the project files. The Scribes™ TR will also be uploaded to the Scribes/CLP portal to pre-notify the receiving laboratory of the shipment. The Sample Log sheets/COCs and Traffic Reports will be completed, signed, and distributed as follows:

- One copy retained by the field team for the sample coordinator and inclusion in the project files; and
- The original sent to the analytical laboratory with the sample shipment.

After the laboratory receives the samples, the Sample Custodian will inventory each shipment before signing for it and note on the original COC form any discrepancy in the number of samples, temperature of the cooler or broken samples. The Project Chemist will be notified immediately of any problems identified with shipped samples. The Project Chemist will in turn notify the QC Specialist, and together they will determine the appropriate course of action. The Project Chemist will also notify the PM if the project budget and schedule may be impacted.

The laboratory will initiate an internal COC that will track the sample within the various areas of the laboratory. The relinquishing signature of the Sample Custodian and the custody acceptance signature of the laboratory personnel transfer custody of the sample. This procedure is followed each time a sample changes hands. The laboratory will archive the samples and maintain its custody as required by the contract or until further notification from the Project Chemist, at which time the samples will be either returned to the project for disposal or disposed of by the laboratory.

27.4 Sample Packing and Shipment

After sample collection and mixing in the plastic zip bags, the composites will be aliquoted to 8-oz glass jars with the Scribes™ created labels affixed. All labels will be covered with clear tape. Each sample will be placed in a re-sealable plastic bag to keep the sample container and label dry. All glass sample containers will be protected with bubble wrap (or other cushioning material) to prevent breakage. A temperature blank will be placed in every cooler with samples requiring temperature preservation. The LBP subcontractor intends to utilize a local testing laboratory, Reservoir Environmental, Inc and will hand deliver any samples under chain of custody.

Samples to be shipped by commercial carrier will be packed in a sample cooler lined with a plastic bag. If temperature preservation is required, ice, bagged in re-sealable bags, will be added to the cooler in sufficient quantity to keep the samples cooled to less than or equal to 6°C for the duration of the shipment to the laboratory. Sample cooler drain spouts will be taped on the inside and outside of the cooler to prevent any leakage. Saturday deliveries will be coordinated with the laboratory.

If a commercial carrier is used, the COC form will be sealed in a re-sealable bag placed inside or taped to the inside of the sample cooler lid. The cooler will be taped shut with packing tape, and custody seals will be taped across the cooler lid. Clear tape will be applied to the custody seals to prevent accidental breakage during shipping. The samples will then be shipped to the analytical laboratory. A copy of the courier air bill, which is part of the sample custody records, will be retained for documentation.

The shipping of samples to the analytical laboratory by land delivery services will be performed according to DOT regulations. The IATA regulations will be adhered to when shipping samples by air courier services. Transportation methods will be selected to assure that the samples arrive at the laboratory in time to permit testing according to established holding times and project schedules. Samples will not be accepted by the receiving laboratory without a properly prepared COC record and properly labeled and sealed shipping container(s). At this time it is not anticipated that samples will require declaration, labeling, and shipment as Dangerous Goods.

27.5 Field Logbooks and Property Log Sheets

Permanently bound field logbooks or loose field log sheets (Field Activity Daily Log, Sample Collection Logs, etc.) will be used during the project to document activities. All entries will be recorded in indelible ink. Corrections will be made following the procedure described in Section 27.6, "Document Corrections." At the end of each workday, the responsible sampler will sign the logbook pages or field sheets; any unused portions of pages will be crossed out, initialed or signed, and dated.

At a minimum, the logbook or field sheets will contain the following information:

- Project name and location;
- Date and time of collection for each sample;
- Sample number;
- Sample location Composite or grab;
- Composite type (the number of grab samples);
- Weather information (e.g., rain, sunny, approximate temperature, etc.);
- Requested analyses.

The project team will utilize the Property Sampling Design Log Sheet specifically developed for the project for each property. This sheet contains the following information:

- A map with the property dimensions, defined sampling areas, and all grab sampling locations shown. The determination of the grab sample distribution and the assigned composites (3) for the property.
- All distinct flower/bed garden areas and the grab sample locations for each 5-point composite, along with the flower bed/garden composite IDs.
- Descriptions of deviations from this SAP/QAPP.
- Problems encountered and corrective action taken.
- Identification of field QC samples and list of QC activities.
- Signature approval of the Project Chemist for the selected sample locations and point distribution.
- Any other events that may affect the samples.

27.6 Document Corrections

Changes or corrections to any project documentation will be made by crossing out the item with a single line, initialing by the person performing the correction, and dating the correction. The original item, although erroneous, will remain legible beneath the cross out. The new information will be written above or near the crossed-out item. Corrections will be written clearly and legibly with indelible ink.

SAP/QAPP WORKSHEET #28 – LABORATORY QC SAMPLE TABLE

SAP/QAPP Worksheet #28.1 – Laboratory QC Samples Table-Metals

Matrix	Soil, water, paint chip and TCLP
Analytical Group	Metals
Analytical Method	USEPA /CLP SOW ISM02.0, and SW-6010C;

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method blank (LCB)	One (1) per batch of twenty samples	No target compounds above ½ the RL	Investigate/correct contamination, rerun LCB. Evaluate all associated samples and qualify all results <RL or >10X blank, reject and repeat results >RL and <10X LCB	Analyst/Supervisor	Bias/Contamination-if has potential to influence decision	Same as Acceptance Limits
LCS	One (1) per batch of twenty samples	90-110% Recovery of spiked value	Evaluate and reanalyze if possible. Qualify samples <RL or >2X LCS concentration if LCS is high. If LCS is low qualify results > 2X LCS spike level, reject all others	Analyst/Supervisor	Bias/Accuracy	Same as Acceptance Limits
MS/MSD	One (1) per batch of twenty samples	80-120% Recovery of spiked value for samples where concentration is <4X spike amount RPD of two results <30	Flag all associated samples with 'Matrix interference' flag Perform Post digest spike	Analyst/Supervisor	Accuracy/Bias and Precision	Same as Acceptance Limits
Post-digestion spike	One per batch of 20 or fewer samples	Recovery of 80-120% of expected	Flag all associated results as J	Analyst/Supervisor	Accuracy/Bias	Same as Acceptance Limits
Serial Dilution	One per batch of 20 or less samples	5X dilution within 10% of original result, if >50X DL	Perform PDS-if data does not agree flag all values J	Analyst/Supervisor	Accuracy/Bias	Same as Acceptance Limits

SAP/QAPP Worksheet #28.2 – Laboratory QC Samples Table GC/MS

Matrix	TCLP, Water, Soil
Analytical Group	VOC/SVOC/PAH-SIM
Analytical Method	CLP SOM02.0

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	One (1) per extraction batch	No target analytes detected greater than ½ LOQ and 1/10 the amount detected in project samples or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no target analytes greater than LOQ in accordance with DoD QSM Table F-4 requirements	Correct problem, then re-extract and reanalyze MB and all samples processed with the contaminated blank in accordance with DoD QSM Table F-4 requirements	Analyst	Representativeness	No target analytes detected greater than ½ LOQ and 1/10 the amount detected in project samples or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no target analytes greater than LOQ in accordance with DoD QSM Table F-4 requirements
LCS or LCS/LCS Duplicate (LCSD) for all target analytes	One (1) per extraction batch per matrix	LCS limits specified in the DoD QSM Appendix G Tables 5 and 7; Laboratory in-house LCS limits if DoD QSM limits not available; RPD less than 30% between LCS and LCSD	Correct problem, then re-extract and reanalyze the LCS and all associated batch samples in accordance with DoD QSM Table F-4 requirements	Analyst	Bias and precision	LCS limits specified in the DoD QSM Appendix G Tables 5 and 7; Laboratory in-house LCS limits if DoD QSM limits not available; RPD less than 30% between LCS and LCSD
MS/MSD for all target analytes for soil samples only	One (1) MS/MSD per extraction batch	LCS limits specified in the DoD QSM Appendix G Tables 5 and 7; Laboratory in-house LCS limits if DoD QSM limits not available; RPD less than 30% between MS and MSD	Identify problem; if not related to matrix interference, re-extract and reanalyze MS/MSD and all associated batch samples in accordance with DoD QSM requirements	Analyst	Bias and precision	LCS limits specified in the DoD QSM Appendix G Tables 5 and 7; Laboratory in-house LCS limits if DoD QSM limits not available; RPD less than 30% between MS and MSD

SAP/QAPP Worksheet #28.2 – Laboratory QC Samples Table GC/MS (continued)

Matrix	TCLP, Water, Soil					
Analytical Group	VOC/SVOC/PAH-SIM					
Analytical Method	CLP SOM02.0					
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Surrogate Spikes	Every field and QC sample	Surrogate acceptance criteria specified in the DoD QSM Appendix G Table G-6; or laboratory in-house surrogate control limits when DoD QSM control limits are not available.	Correct problem, then re-extract and reanalyze all affected samples in accordance with DoD QSM Table F-4 requirements.	Analyst	Bias	Surrogate acceptance criteria specified in the DoD QSM Appendix G Table G-6; Laboratory in-house control limits if DoD QSM limits are not available.
ISTD	Every field and QC sample	Retention time within ± 30 seconds from retention time of the mid-point standard in ICAL; and area count within -50% to +100% of mid-point standard in ICAL in accordance with DoD QSM Table F-4 requirements.	Correct problem, then re-extract and reanalyze affected samples.	Analyst	Bias	Retention time within ± 30 seconds from retention time of the mid-point standard in ICAL; and area count within -50% to +100% of mid-point standard in ICAL in accordance with DoD QSM Table F-4 requirements.
Method Detection Limit (MDL) study (Ottawa sand)	Initial setup, once per 12-month period or quarterly MDL verification	Detection limits (DLs) established will be below the RLs.	Correct problem, then repeat the MDL study in accordance with DoD QSM Table F-4 requirements.	Lab Manager / Analyst	Sensitivity	
LOD study (Ottawa sand)	Initial setup, and quarterly LOD verification	Signal to noise ratio at the LOD will be greater than 3 and meet method requirements.	Correct problem, then repeat DL study and LOD verification at a higher concentration, or pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration in accordance with DoD QSM Table F-4 requirements.	Lab Manager / Analyst	Sensitivity	
LOQ study (Ottawa sand)	Annually and quarterly verification	LOQ will be greater than LOD and within calibration range. Laboratory procedure for establishing the LOQ will empirically demonstrate precision and bias at the LOQ.		Lab Manager / Analyst	Sensitivity	

SAP/QAPP Worksheet #28.3 – Laboratory QC Samples Table GC

Matrix	TCLP, Water, Soil					
Analytical Group	Pesticides, PCBs, Herbicides					
Analytical Method	CLP SOM02.0					
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
MB	One (1) per extraction batch	No target analytes detected greater than ½ LOQ and 1/10 the amount detected in project samples or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no target analytes greater than LOQ in accordance with DoD QSM Table F-2 requirements.	Correct problem, then re-extract and reanalyze MB and all samples processed with the contaminated blank in accordance with DoD QSM Table F-2 requirements.	Laboratory Analyst	Representativeness	No target analytes detected greater than ½ LOQ and 1/10 the amount detected in project samples or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no target analytes greater than LOQ.
LCS or LCS/LCSD for all target analytes	One (1) per extraction batch per matrix	Laboratory in-house LCS limits; RPD less than 30% between LCS and LCSD.	Correct problem, then re-extract and reanalyze the LCS and all associated batch samples in accordance with DoD QSM Table F-2 requirements.	Laboratory Analyst	Bias and precision	Laboratory in-house LCS limits; RPD less than 30% between LCS and LCSD.
MS/MSD for all target analytes for soil matrix only	One (1) MS/MSD per each extraction batch	Laboratory in-house LCS limits; RPD less than 30% between MS and MSD.	Identify problem; if not related to matrix interference, re-extract and reanalyze MS/MSD and all associated batch samples in accordance with DoD QSM Table F-2 requirements.	Laboratory Analyst	Bias and Precision	Laboratory in-house LCS limits; RPD less than 30% between MS and MSD.

SAP/QAPP Worksheet #28.3 – Laboratory QC Samples Table GC (continued)

Matrix	TCLP, Water, Soil					
Analytical Group	Pesticides, PCBs, Herbicides					
Analytical Method	CLP SOM02.0					
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Surrogate Spikes	Every field and QC sample	Laboratory surrogate recovery control limits.	Correct problem, then re-extract and reanalyze all affected samples in accordance with DoD QSM Table F-2 requirements.	Laboratory Analyst	Bias	Laboratory surrogate recovery control limits
MDL study (Ottawa sand)	Initial setup, once per 12-month period or quarterly MDL verification	DLs established will be below the RLs.	Correct problem, then repeat the MDL study in accordance with DoD QSM Table F-2 requirements.	Lab Manager / Analyst	Sensitivity	
LOD study (Ottawa sand)	Initial setup, and quarterly LOD verification	Signal to noise ratio at the LOD will be greater than 3 and meet method requirements.	Correct problem, then repeat DL study and LOD verification at a higher concentration, or pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration in accordance with DoD QSM Table F-2 requirements.	Lab Manager / Analyst	Sensitivity	
LOQ study (Ottawa sand)	Annually and quarterly verification	LOQ will be greater than LOD and within calibration range. Laboratory procedure for establishing the LOQ will empirically demonstrate precision and bias at the LOQ.		Lab Manager / Analyst	Sensitivity	

SAP/QAPP WORKSHEET #29 – PROJECT DOCUMENTS AND RECORDS TABLE

Document	Where Maintained
Final Site Investigation Sampling and Analysis Work Plan	Shaw Project file U.S. Army Corps of Engineers – Omaha District (USACE) USEPA Region 8 Office
Field notes/logbook and Property Sampling Design Layout Sheets	Shaw Project file USACE Scanned into EPA data-base Final Report
Property Investigation/Decision Packages	Shaw Project file USACE Scanned into EPA data-base Final Report
COC forms and Scribes™ generated CLP Traffic Reports	Shaw Project file CLP laboratories Final Report
Daily Quality Control Reports	Shaw Project File Shaw QC Manager USACE Final Report
Laboratory reports/raw data package	Shaw Project file Final Report CLP Laboratories EPA CLP repository
Audit/assessment checklists/reports	Shaw Project file Final report
Corrective action forms/reports	Shaw Project file CLP Laboratories
Laboratory equipment calibration logs	CLP Laboratories
Sample preparation logs	CLP Laboratories
Run logs	CLP Laboratories
Sample disposal records	CLP Laboratories
Data Validation Reports	Shaw Project file

Document	Where Maintained
Electronic Validated data	Shaw Project file Final Report Shaw project GIS and Shaw Environmental Information Management System (EIMS) CLP repository

SAP/QAPP WORKSHEET #30 – ANALYTICAL SERVICES TABLE

Matrix	Analytical Group	Sample Locations/ ID Numbers ¹	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Soil	Metals-Arsenic and Lead only	See Worksheet #18	CLP lab specific	14-business days unless EPA changes	Contract Laboratory Program (CLP) assigned laboratory-lab assigned 1-1/2 weeks before sample delivery	CLP assigns the laboratory as ordered from the entire network based on capacity
Paint Chips	Metals-Lead only TCLP, Lead	See Worksheet #18		14-business days	Contract Laboratory Program (CLP) assigned laboratory-lab assigned 1-1/2 weeks before sample delivery	CLP assigns the laboratory as ordered from the entire network based on capacity
Soil and Water - IDW	TCLP, Metals as needed; TCLP for; Volatiles, Semi-Volatiles, Pesticides, and Herbicides, total PCBs	See Worksheet #18	CLP lab specific	14 Business Days	Contract Laboratory Program (CLP) assigned laboratory-lab assigned 1-1/2 weeks before sample delivery	CLP assigns the laboratory as ordered from the entire network based on capacity
Soil, fill, rock, and cover material	Metals-Arsenic and Lead only	See Worksheet #18	CLP lab specific	14 Business Days	Contract Laboratory Program (CLP) assigned laboratory-lab assigned 1-1/2 weeks before sample delivery	CLP assigns the laboratory as ordered from the entire network based on capacity
Topsoil	Metals Volatiles Semi-volatiles Pesticides/PCBs Herbicides	See Worksheet #18	CLP lab specific	14 Business Days	Contract Laboratory Program (CLP) assigned laboratory-lab assigned 1-1/2 weeks before sample delivery	CLP assigns the laboratory as ordered from the entire network based on capacity
Topsoil	Hexavalent chromium	See Worksheet #18				

Matrix	Analytical Group	Sample Locations/ ID Numbers ¹	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Topsoil	Agricultural parameters; Nitrogen, phosphorous, organic content, pH	See Worksheet #18		14-business days	Colorado State University-Soil, Water, and Plant Testing Laboratory Room A319, Natural and Environmental Sciences Building 200 West Lake Street Fort Collins, CO 80523 James R. Self, PhD 970-491-5061	Not Determined

Note(s):

- Should validation criteria for non-standard or unpublished methodologies be required for a given study on a task-specific basis, it will be identified in the appropriate work plan.*
- The laboratory Project Manager identified in Worksheets #3 and Worksheet #7 is responsible for overseeing the success of the analyses and for implementing corrective action, if deemed necessary.*

SAPQAPP WORKSHEET #31 – PLANNED PROJECT ASSESSMENTS TABLE

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
QCSR	Each definable feature of work	Internal	Shaw	Project Chemist Erica Koch	NA	NA	NA
Receipt Inspection	At start of project and as materials are received	Internal	Shaw	/Project Chemist Erica Koch	Technical Lead, On-Site QC, or Task Lead	Technical Lead, On-Site QC, or Task Lead	QA/QC Manager John Patin Program Chemist Guy Gallelo, Jr.
Preparatory Inspections	Task kick-off	Internal	Shaw	Technical Lead, On-Site QC, or Task Lead	Technical Lead; On-Site QC, or Task Lead	Technical Lead, On-Site QC, or Task Lead	QA/QC Manager John Patin Program Chemist Guy Gallelo, Jr.
Initial Inspection	At start of the definable feature of work	Internal	Shaw	Technical Lead, On-Site QC, or Task Lead	Staff member would be assigned based on the assessment findings	Staff member would be assigned based on the assessment findings	Technical Lead, On-Site QC, or Task Lead
Follow-up Inspections	Minimum daily surveillance or as required by task.	Internal	Shaw	Technical Lead, On-Site QC, or Task Lead	Staff member would be assigned based on the assessment findings	Staff member would be assigned based on the assessment findings	Technical Lead, On-Site QC, or Task Lead
Final Inspections	At conclusion of task	Internal	Shaw	Technical Lead, On-Site QC, or Task Lead	Staff member would be assigned based on the assessment findings	Staff member would be assigned based on the assessment findings	Technical Lead, On-Site QC, or Task Lead

Table 31-1

Assessment and Audit Frequency

Technical inspections and assessments will be conducted during initial stages of fieldwork to identify and correct problems as quickly as possible. Independent assessments will be performed at least annually. USACE and/or EPA can conduct assessments at any time and without prior notification to Shaw. Laboratory assessments are the responsibility of the CLP and by utilizing the CLP sample management system, Shaw will be assured of using a laboratory whose CLP approval is current. Each CLP laboratory is also required by the program to conduct inspections and maintain inventories and certifications of all supplies and expendables. The details of these procedures are included in individual SOPs and/or the laboratory Quality Management Plans and evaluated as part of the CLP program laboratory approval process.

Inspections for Field Activities

The Project Chemist will conduct inspections of all sampling equipment and associated expendables. Inspections will be performed on materials or services to determine compliance with contractual, planning, and other requirements. Criteria will be established prior to the inspection and will be based on project specifications, requirements, code specifications, and product acceptability and will be conducted in accordance with Procedure EI-Q005, *Inspection*. Acceptance criteria will be adequate for the activity and will be verified during inspection activities. Inspection may be performed and verified through visual observation, measurement of materials or equipment, examination of documentation/certification, evaluation of performance, or testing. Inspections may be performed using the three-phase inspection method. The preparatory inspections will be performed prior to startup and will examine training, procedures, equipment and materials, work plans and documents, and overall readiness to perform work. Initial inspections will be performed when work begins on a particular feature of work and will include an examination of the quality of workmanship and a review of control testing for compliance with contract and work plan requirements. Follow-up inspections will be performed to verify compliance with procedures and will ensure the continuation of quality and safety standards established during preparatory and initial inspections until completion of the definable work feature. Final follow-up inspections will be conducted at the completion of each task. Participants in this inspection may include QA (USACE/EPA and QC (Shaw). The final follow-up inspection will be performed to ensure that the completed feature of work meets contract requirements. Any deficiencies noted during this inspection will be documented, and a determination will be made as to the CAs necessary to mitigate the deficiency. All significant deficiencies must be corrected prior to turnover.

Records of inspections will be maintained in the project files. At a minimum, inspection files will include inspection reports/checklists, inspection responses, any supporting documents, and applicable client comments.

Assessment Findings and Corrective Action

All observations and assessment findings will be documented, and the checklist will be submitted with a written assessment and recommendations, including any required or recommended CAs to the QA Manager, PM, and USACE PM and QA Manager. Notification to EPA (RPM/QA Manager) will be conducted through USACE. The information and any CA documentation also will be summarized and included in program reports. EPA and other regulatory agencies shall be notified of any significant CAs by USACE.

SAP/QAPP WORKSHEET #32 – ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Technical System Audit	Written Audit Report	Shaw PM or Technical Manager	48 hours after audit	Email or letter	Field Technician, Shaw Project Chemist, Shaw PM, USACE COR	24 hours after notification
Field documentation audits	Written Audit Report	Shaw PM, Field Technicians, Project QC Manager, Project Chemist	48 hours after audit	Email or letter	Shaw PM, Field Technicians, Project QC Manager, Project Chemist, Program Chemist, UACE COR	24 hours after notification
Laboratory Data Review Findings	Memo	Laboratory QA Manager, Laboratory PM	48 hours after audit	Email or letter	Shaw Project Chemist, Shaw PM, USACE COR	3 days after notification

SAP/QAPP WORKSHEET #33 – QA MANAGEMENT REPORTS TABLE

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Daily Quality Control Report	Daily	Daily	Shaw Project QC Manager/Project Chemist	USACE PM, Shaw Program Chemist, Shaw PM
Field Sampling, Audit Report Initial and Follow up inspections	At least once at the beginning of sampling activities and then as needed as the project progresses	Within 24 hours of Field Sampling Audit	Shaw Project QC Manager or Shaw Project Chemist, initial report produced by Shaw Program Chemist	USACE PM, Shaw Program Chemist, Shaw PM
Data Review Report-CLP and other results	After sample data reviewed by Program Chemist	As received from laboratory	Shaw Program Chemist	USACE PM, Shaw PM
Final Project Quality Assurance Report	After completion of all field work or as directed by EPA/USACE	Sixty days following completion of all property investigation and removal actions	Shaw Project Chemist and Shaw Program Chemist	Shaw PM, USACE PM

SAP/QAPP WORKSHEET #34 – VERIFICATION (STEP I) PROCESS TABLE

Verification Input	Description	Internal/External	Responsible for Verification (Name, Organization)
Property Sampling Designs	Property Design/Sample Location sheets will be reviewed for adherence to the procedure, proper definition of accessible sample areas, and proper distribution of sample points through defined areas. Reviewer will also confirm that all gardens/flower-beds are represented by individual composites in the design	Internal	Project Chemist – prior to sample collection
COC forms/CLP Traffic reports	Traffic reports forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the COC should be initialed by the reviewer, a copy of the COC retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	Internal	Project Chemist
Field notes/logbook	Field notes will be reviewed internally and placed in the project file upon project completion.	Internal	Project Chemist
Entry into Project/EPA data-base	Daily entries into the project/EPA data-base are checked for accuracy and completion of the project-defined properties. The QC check includes a property by property cross-check of all data entered against the property sample IDs results, CLP (if applicable), and a check for reasonableness in the standard deviation of the three composite values	Internal	Project Chemist or designate Program Chemist as part of audit process
Audit reports	Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the PM will be notified to ensure action is taken.	Internal	Shaw Program Chemist

Verification Input	Description	Internal/External	Responsible for Verification (Name, Organization)
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received data packages will be verified by the Shaw Program Chemist or designate. The CLP provides data electronically which has been "checked" against the National Functional Guidelines for Superfund Inorganic Data Review (2010). The NFG report will be checked as a preliminary step and any questionable data will be further evaluated against the NFGs as a full data package	Internal	Laboratory PM, Shaw Program Chemist or designate
EDDs	All EDDs will be verified internally by the subcontract laboratory for completeness and technical accuracy prior to submittal to Shaw. All received EDDs will be verified by Shaw against the hardcopy laboratory reports	Internal/External	Laboratory PM, Shaw Program Chemist or designate

SAP/QAPP WORKSHEET #35 – VALIDATION (STEPS IIA AND IIB) PROCESS TABLE

Step IIA/IIB	Validation Input	Description	Responsible for Validation (Name, Organization)
Ila	Compliance Review	Review all laboratory information against Request for Analysis and determine if all samples were preserved, received, and analyzed with project specifications. Determine if sample group delivery (SGD) is complete.	Shaw Program Chemist
Ila, Iib	Inorganics Level 1 EPA Organics Level 1 EPA	Level III (QC review only): Perform first-level data validation review. Complete automated data review report and verify exception list or complete data validation checklist based on NFG and project requirements.	Shaw Program Chemist
Ila, Iib	Organics and Inorganics EPA Level 3 Data Validation (or equivalent)	EPA Level 3 (QC validation or equivalent): Perform first-level data validation review. Complete automated data review report and verify exception list or complete data validation checklist based on NFG and project requirements.	Shaw Program Chemist
Iib	QC Summary Report	Review data validation results and provide concurrence, determine data usability and summarize data quality issues.	Shaw Program Chemist

Notes:

Sample data are validated by the Shaw Program Chemist using the EPA's contract laboratory *National Functional Guidelines for Superfund Inorganic Data Review* (EPA, 2010) for guidance

Data validation is based on the NFG as guidance and applies the validation criteria provided in the QAPP (WS

LCS and MS/MSD control limits are presented in Worksheets #12 and #28.

The attached tables list general qualifier guidelines used for the data validation process.

SAP/QAPP WORKSHEET #35 – VALIDATION (STEPS IIA AND IIB) PROCESS TABLE

Table 35-1 – Validator General Flagging Guidelines

QC Requirement	Criteria	Flag	Flag Applied to
Holding Time	Time exceeded for completion of extraction or analyses	R for nondetects > 2X hold time, or J for the positive results	All analytes in the sample. In the event that holding time is only marginally exceeded, qualify positive results as J
LCS	Percent recovery (%R) > Upper control limit (UCL) %R < lower control limit (LCL) %R < 10%	J for the positive results J for the positive results UJ for the nondetects J for the positive results UJ for the nondetects	The specific analyte(s) in all samples in the associated analytical batch
LCSD	RPD > CL	J/UJ for all results	The specific analyte(s) in all samples in the associated analytical batch
Method Blank	Analyte(s) detected	UB for the results within 5X the blank concentration	The specific analyte(s) in all samples in the associated analytical batch
Equipment Blank	Analyte(s) detected	UB for the results within 5X the blank concentration	The specific analyte(s) in all samples with the same sampling date and sampling equipment as the equipment blank
Field Duplicates	Field duplicates > RLs And RPD outside control limits 20 Water; 70 Soil	J for the positive results or UJ for the nondetects	The specific analyte(s) in all samples with the same sampling date and sampling by the same sampling crew at the same site
MS/MSD	MS or MSD %R > UCL or MS or MSD %R < LCL or MS or MSD %R < 10% MS/MSD RPD > CL	J for all positive results J/UJ for all results J/UJ for all results	Where the concentration in the parent sample is < 4 times the spike concentration. Qualify MS/MSD sample only. Use professional judgment to qualify other samples in batch

QC Requirement	Criteria	Flag	Flag Applied to
Sample Preservation / Collection	Preservation / collection requirements not met	Professional judgment will be used for validation of samples when standard temperature guidelines are marginally exceeded	All analytes in the sample
Laboratory Sample Storage	4 ± 2°C	J for the positive results UJ/R for the nondetects	All analytes in the sample

Notes:

CL – Control Limit

J – Results estimated during data validation

LCS – Laboratory Control Sample

LCSD – Laboratory Control Sample Duplicate

LCL – Lower Control Limit

MS – Matrix Spike

MSD – Matrix Spike Duplicate

%R –Percent Recovery

R – Rejected (during data validation)

RPD – Relative Percent Difference

UCL – Upper Control Limit

UJ – Nondetected results estimated during data validation

UB – Result determined to be nondetect at reported concentrations during validation due to contamination in an associated blank

Control limits for criteria listed in this table are found on Worksheet #12 and Worksheet #28

SAP/QAPP WORKSHEET #35 – VALIDATION (STEPS IIA AND IIB) PROCESS TABLE

Table 35-2 – Guidelines for Reporting Results

Result	Flag*
LOQ	U
> DL < LOQ	J
≥ LOQ	As needed

* Example 1: If the DL is 0.04, the LOQ is 0.9, and the result is 0.03, the concentration reported on the tabulated data form would be ND (0.9) (the sample specific LOQ) and the qualifier would be U.

Example 2: If the DL is 0.04, the LOQ is 0.9, and the result is 0.07, the concentration reported on the result form would be 0.07 and the qualifier flag would be J.

Example 3: If the DL is 0.04, the LOQ is 0.9, and the result is 1.2, the concentration reported on the result form would be 1.2 and the qualifier would be any flag needed because of a data quality problem (e.g., R, J, B, etc.).

Notes:

DL – Decision Limit

J – Estimated results, detected above the detection limit but below the LOQ

LOQ – Limits of Quantitation

U – Results not detected

SAP/QAPP WORKSHEET #36 – ANALYTICAL DATA VALIDATION (STEPS IIA AND IIB) SUMMARY TABLE

Step IIA/IIB	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa and IIb	Soil and IDW	CLP-As, Pb, Metals, Volatiles, Semi- volatiles, Pesticides/PCBS, Herbicides, TCLP, metals, volatiles, semi- volatiles, pesticides, herbicides LBP-Metals, lead, TCLP, metals (lead)	QC criteria specified in this SAP/QAPP USEPA Methods, USACE Guidance for Evaluation Performance Based Data (June 30, 2005), USEPA Contract Laboratory Program, National Functional Guidelines, and the DoD QSM Version 4.2, 2010 unless superseded by CLP SOW and USACE variance is allowed.	Shaw Program Chemist and/or designated data reviewer

SAP WORKSHEET #37 – USABILITY ASSESSMENT

Personnel Responsibilities Regards To Data Quality Assessment:

The Shaw Program Chemist is primarily responsible for the overall assessment of data quality and usability, including the off-site CLP generated data. The Program Chemist will produce a checklist styled “decision sheet” for each property investigated. At the field/project level, the Project Chemist will provide for defensibility of the sampling designs for each property by review and approval of each property sample location map before the samples are collected. The Program Chemist completes the data review process by reviewing areas in which data non-conformances were identified by the validator. If data are determined to be un-usable (e.g. “R-flagged”), impacts (e.g. critical samples/analytes) to the project are evaluated on a case-by-case basis to determine if re-sampling or re-analysis is warranted through a corrective action report to ensure that only reliable results are used by the project and that enough usable data is available to support the decisions being made. The corrective action report addresses how this problem will be resolved and corrective actions implemented.

Data Quality Assessment Procedures:

Since the primary means of achieving objectives stems from the actual sample locations and composite creation within each property, the Shaw Project Chemist will perform the QC check/approval for each property investigation design. He/she will evaluate the sampling sheet for each property and approve the design and sample location distribution prior to sample collection. This will ensure that the samples submitted conform to the SOP, represent the entire accessible area of the property, and have been distributed in the properly weighted fashion throughout the property.

Field data generated by the field personnel is initially reviewed, processed, and evaluated on site by the Project Chemist. Copies of the original forms are maintained on site for reference, and the originals are then forwarded to the data coordinator for further review, inclusion into the project database, and final storage in the project central files. A scan is also provided to the Program Chemist of each property sample map. All CLP data will be provided directly to the Program Chemist. Preliminary results will be provided in the CLP-format Excel file and CLP Summary Report. The complete CLP report package will be provided with the final data.

The data usability assessment performed by the Shaw Program Chemist for each property will evaluate all aspects of the sampling and analytical process for adherence with procedures, proper field instrument calibration, performance, and operation, comparison to DQOs, and overall statistical reasonableness in the

UCL-95 determination, i.e. do the mean and standard deviation justify the data use for UCL-95 calculations.

The program chemist performs the usability assessment on analytical data, as defined by precision, accuracy, representativeness, comparability, completeness (PARCC), and sensitivity definitions. A combination of checklists and/or data validation summaries are used to document data validation activities. A quality control summary report (QCSR) or similar document will be used to summarize the DQO compliance for the entire project and will be included as part of the final report.

All applicable analyses should meet the recommended DOD QSM V4.2 as well as the requirements dictated in the current CLP-SOW for inorganic analysis.

Evaluation of PARCC Parameters:

Part of the review to determine whether DQOs are met involves evaluating a series of data quality indicators that include measurements of the PARCC and sensitivity parameters. How each of these measurements is to be performed and assessed is discussed here-in. The target acceptance criteria for the results have been developed for anticipated analyses on soils and are presented in Worksheets 12, 15, 19, and 28. The data quality indicators include:

Precision

Precision refers to the reproducibility of measurements and is defined as the measurement of mutual agreement among individual measurements of the same property, usually under “prescribed similar conditions.” Analytical precision is assessed through the analysis of lab duplicates, field duplicates, MSDs, and lab sample duplicates. Precision is expressed in terms of the relative percent difference (RPD) between duplicate determinations or in terms of the relative standard deviation (RSD) when three or more determinations are made. Various measures of precision exist, depending on the prescribed similar conditions. Overall sampling and analysis precision are assessed using RPD for duplicate environmental samples. If results are near the detection limit or one value is flagged as estimated, alternatively the absolute difference between values can be assessed. The RPD for MS/MSD sample results are used to assess laboratory spike recovery precision. RPD is defined as the difference between two measurements divided by their mean and expressed as a percent, as shown in Equation (1):

Eq. (1)

$$RPD = \{ \text{Absolute Value } (D_1 - D_2) / \text{Average } (D_1, D_2) \} \times 100$$

where:

- D_1 = The result from the original determination
 D_2 = The result from a duplicate measurement.

RSD is the standard deviation of a set of values divided by the average value expressed as a percent, as shown in Equation (2):

Eq. (2)

$$RSD = \left(\frac{\sigma_{n-1}}{\bar{X}(x_1 \dots x_n)} \right) \times 100$$

where:

- σ_{n-1} = The sample standard deviation of the sample data
 n = The number of determinations

$\bar{X}(x_1 \dots x_n)$ = The arithmetic mean of the sample data.

Precision as RPD will be evaluated in several ways for this project. Field duplicates (co-created) composites will be used to determine if the sampling and analysis processes are producing reproducible data. In cases where the results are either flagged as estimated for one or both samples or close to the reporting/detection limit, absolute difference [R1-R2] may be evaluated with a criteria of being less than 10X the MDL. The CLP laboratory will also be preparing and analyzing site-specific matrix spike and matrix spike duplicate pairs (MS/MSD) to evaluate its precision and ability to recover the target analytes from the site matrix. RSD will be used to evaluate the comparability and statistical defensibility of the three property composites prior to determining the UCL-95 values.

Accuracy

Accuracy is a measure of the bias in a system or the degree of agreement of a measurement X (or an average of measurements of the same parameter) against an accepted reference or true value, T. Accuracy is typically expressed as a percent recovery calculated by the ratio of the measurement and accepted true value, as shown in Equation (3):

Eq. (3)

$$\text{Percent Recovery} = \left(\frac{(X - S)}{T} \right) \times 100$$

where:

- X = The experimentally determined concentration
 S = The sample concentration before spiking
 T = The "true" concentration.

Analytical accuracy will be assessed for this project in different ways, based upon the capabilities of the methods in use. Samples sent for CLP analysis will be assessed for accuracy through the analysis of spikes (LCS, MS/MSD, and post-digestion if required) and calibration check verification samples. With the MS/MSDs that are spiked onto the actual sample matrix and analyzed, these accuracy indicators must take into account the nature of the matrix in question and the native concentration of the analyte spiked. Matrix variability or interferences from high concentrations of native compounds may adversely affect spike recovery and yield less than conclusive data.

Accuracy will also be controlled by the use of blanks which can indicate the level of contamination present in the sampling and/or analytical system. Sampling contamination will be evaluated by using field blanks. These will be clean sand samples collected using the decontaminated sampling implements. Each sampling team will produce one field blank per sampling day. Field blanks will be evaluated and the results used to ascertain if the decision for a property may have been skewed by contaminated sampling implements and if the decon process needs to be improved. However, the action-levels for both arsenic and lead are sufficiently high enough for data to not require qualification and/or rejection due to contaminated blanks unless that contamination is very significant (>50% of action-levels).

Sensitivity

Sensitivity is a quantitative parameter that addresses the ability of the analytical method or instrumentation to differentiate between responses that represent concentrations of analytes. Sensitivity is important, as it is the ability to detect the target analytes at the levels of interest so that project-specific goals are met. The requirements of sensitivity include the establishment of various limits, such as those for calibration which include MDLs and QLs (these values are provided in the tables in Worksheet #15) and those that are sample specific, such as RLs. Both MDLs and QLs are based on interference-free matrices that do not take into account the matrix effects of environmental samples. Therefore, project-specific RLs are evaluated to meet project objectives for analytes of interest during data assessments with the final reported data. The reporting limits specified in the CLP SOW, and established by the instrument calibration range are sufficiently below the site action-levels to ensure confidence in reported data.

Representativeness

Representativeness is a qualitative parameter that expresses the degree to which sample data actually represent the matrix conditions. Requirements and procedures for sample collection and handling are designed to maximize sample representativeness. Representativeness can also be monitored by reviewing field documentation and by performing field QA audits. The procedures in use were previously

extensively evaluated and therefore, representativeness will be assured by conforming to the sampling designs, and preparation methods contained in the QAPP and taken from the approved 1999 planning document. Representativeness will be evaluated at the field/sample design level, by the project chemist and at the overall completion level by the program chemist.

Completeness

Data completeness represents the percentage of usable data collected from a sampling/analytical program or measurement system compared to the amount expected to be obtained under optimal or normal conditions. Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of usable results divided by the number of possible individual analyte results and expressed as a percentage determines the completeness of the data set. For completeness requirements, usable results are all results not qualified as rejected in the data review and validation process. Since all of the property related samples are considered critical measures, the requirement for completeness is 90 percent of all property and flower bed/garden composite samples and associated QC measures; field blanks, duplicates, and CLP lab batch QC. IDW analysis will be assigned an 80-percent completeness goal. .

The formula for calculating completeness is shown in Equation (4):

Eq. 4

$$\text{Completeness} = \left(\frac{\text{number of valid (i.e., non - Rflagged) results}}{\text{number of possible results}} \right)$$

For statistically based sampling designs, completeness will be dependent upon the number of usable samples that are needed to meet the tolerances for decision errors. The mechanism for determining completeness for statistically based sampling designs will be provided in the site-specific QAPP.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Comparability for sampling and analysis tasks is achieved by:

- Specifying well-recognized techniques and accepted standard methods for sampling and analysis using well-trained sampling and analysis technicians to consistently execute the prescribed methods.

- Requiring that all involved sampling and analysis personnel produce adequate documentation to record how the prescribed methods were actually executed, noting non-conformances and corrective measures taken.

The specification of standardized laboratory methods helps to ensure that the data generated for an event are comparable to past and future activities. Periodic field and laboratory audits to assess consistency of method implementation for these prescribed procedures are also critical in determining comparability. Comparability to the past phases of the work will be achieved by utilizing the same procedures for sampling and analysis as those in the 1999 planning document.

The following guidelines will be considered during evaluation for usability:

- Review the case narratives pertaining to the data packages and establish that corrective actions (CA) were performed.
- Review all validation qualifier flags based on acceptance criteria.
- Ascertain if the representativeness objective for the project was achieved.
- Consider previous investigations for the specific projects and for pre-existing data gaps.
- Calculate completeness of sample and analytical data collection to check against the objectives of the project.
- Identify data gaps based on completeness and nonconformance events.
- Identify data that do not meet project-specific sensitivity requirements.
- Evaluate if the data gaps prevent from making decisions intended in DQOs.
- Document instances where professional judgment should be used and discuss them with the U.S. Army Chemist.
- Document all evaluations, calculation, rejections, and recommendations and provide rationale for all specific validation actions.

Instead of a checklist, the data validation will be completed in a narrative memo format, modeled from the example/template provided in the Shaw SOP for Data Usability Review, provided in Attachment 2. If there are usability issues discovered in the 10-percent review for a package, the entire package will be reviewed. The data usability memo will clearly communicate/list any quality issues or qualifications which affect the use of individual data points and the Project Chemist will be notified by e-mail that data is questionable so that USACE and/or EPA can be consulted for direction as to resampling or other solutions.

REFERENCES

Code of Federal Regulations, 2006, 40 CFR 261.24 Toxicity Characteristic Table 1 FR 40259, July 14, 2006.

Intergovernmental Data Quality Task Force, 2005, *Uniform Federal Policy (UFP) for Quality Assurance Project Plans (QAPPs): Evaluating, Assessing, and Documenting Environmental Collection and Use Programs Part 2A: UFP-QAPP Workbook*, USEPA-505-B-04-900C, U.S. Department of Defense, U.S. Department of Energy, and U.S. Environmental Protection Agency, Washington, D.C., March.

Record of Decision, Vasquez Boulevard/Interstate 70 Superfund Site, Operable Unit 01, Residential Soils, United States Environmental Protection Agency, Region 8, September 25, 2003

U.S. Army Corps of Engineers (USACE). 2001. *Requirements for the Preparation of Sampling and Analysis Plans*. EM 200-1-3.

U.S. Department of Defense (DoD), 2010, *DoD Quality Systems Manual for Environmental Laboratories*, Version 4.2, U.S. Department of Defense Environmental Data Quality Workgroup, Washington, D.C.

U.S. Environmental Protection Agency (USEPA), 1986, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd ed., Including All Promulgated Updates and New Methods, U.S. Environmental Protection Agency, Washington, D.C., July 2010.

U.S. Environmental Protection Agency (USEPA), 1996, *Test Methods for Evaluating Solid Waste, Physical Chemical Methods*, SW-846, Update III and IV.

U.S. Environmental Protection Agency (USEPA). 2001a. *USEPA Requirements for Quality Assurance Project Plans (QA/R-5)*, U.S. Environmental Protection Agency, Washington, D.C., March 2001.

U.S. Environmental Protection Agency (USEPA), 2002, *Guidance for Quality Assurance Project Plans*, USEPA QA/G-5, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (USEPA), 2008, *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*, OSWER 9240.1-48, USEPA 540-R-08-01, U.S. Environmental Protection Agency, Washington, D.C., June. U.S. Environmental Protection Agency (USEPA), 2010, *Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review*, OSWER 9240.1-51, USEPA 540-R-10-011, U.S. Environmental Protection Agency, Washington, D.C., January.

U.S. Environmental Protection Agency (USEPA), 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, USEPA QA/G-4, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (USEPA), Region 8, 1999 *Project Plan for the Vasquez Boulevard and I-70 Site, Denver Colorado, Phase III Field Investigation, August 1999*

U.S. Environmental Protection Agency (USEPA), Region 8, 2004, *Remedial Design Work Plan for Soil Sampling and Remediation Program Operable Unit 1 Vasquez Boulevard and Interstate 70 Superfund Site, Denver Colorado, Phase III Field Investigation, July 2004, prepared by Project Resources, Inc. San Diego, CA*

Appendix A

1999 Document without attachments and appendices



2039988

COPY**PROJECT PLAN**

for the

**VASQUEZ BOULEVARD & I-70 SITE
DENVER, CO****PHASE III FIELD INVESTIGATION**

August 4, 1999



Prepared For:
U.S. Environmental Protection Agency, Region 8
999 18th Street, Suite 500
Denver, CO 80202



Prepared By:
ISSI Consulting Group, Inc.
999 18th Street, Suite 1450
Denver, CO

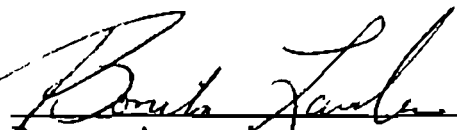
Basic Contract No.: SBAHQ-98-D-0002
Project No.: 96290-ARA-01

EPA IAG No.: DW47953681

Delivery Order No.: 0008
Requisition No.: 9.5770.0175

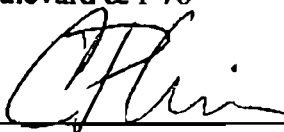
APPROVAL PAGE

This Project Plan for the Vasquez Boulevard and I-70 Site - Phase III Field Investigation has been prepared at the request of the U.S. Environmental Protection Agency, Region 8, by ISSI Consulting Group, Inc. Study investigations and activities addressed in this Project Plan are approved without condition.



Program Approval
Bonita Lavelle
USEPA Remedial Project Manager
Vasquez Boulevard & I-70

8-4-99
Date



Technical Approval
Christopher Weis, PhD, DABT
USEPA Regional Toxicologist
Office of Ecosystems Protection and Remediation

8/4/99
Date

TABLE OF CONTENTS

1.0	BACKGROUND AND STUDY OBJECTIVES	1-1
1.1	<u>Key Personnel</u>	1-1
1.2	<u>Project Background</u>	1-2
1.3	<u>Study Objectives</u>	1-4
1.4	<u>Project Description</u>	1-5
2.0	DATA QUALITY OBJECTIVES AND STUDY DESIGN	2-1
2.1	<u>Residential Soil Sampling</u>	2-1
2.1.1	Data Quality Objectives	2-1
2.1.2	Study Design	2-4
2.2	<u>Indoor Dust Sampling</u>	2-10
2.2.1	Data Quality Objectives	2-10
2.2.2	Study Design	2-12
2.3	<u>Alley Soil Pilot Study</u>	2-14
2.3.1	Data Quality Objectives	2-14
2.3.2	Study Design	2-15
2.4	<u>Characterization of Schools and Parks</u>	2-17
2.4.1	Data Quality Objectives	2-17
2.4.2	Study Design	2-18
3.0	FIELD SAMPLING PLAN	3-1
3.1	<u>Staff Identification</u>	3-1
3.2	<u>Property Access Agreements</u>	3-1
3.2.1	Obtaining Access Agreements	3-2
3.2.1.1	Site-Wide Mailing	3-2
3.2.1.2	Door-to-Door Recruitment	3-3
3.2.1.3	Follow-up Mailings and Recruitment Activities	3-3
3.2.2	Documentation	3-3
3.3	<u>Phase III Field Sampling</u>	3-4
3.4	<u>Residential Yard Soils</u>	3-4
3.4.1	Residence Identification	3-5
3.4.2	Identification and Collection of Yard Soil Samples	3-5
3.4.3	Field Documentation	3-8
3.4.4	Sample Preparation	3-9
3.4.5	Analytical Method Requirements	3-10
3.5	<u>Indoor Dust Samples</u>	3-11
3.5.1	Identification of Indoor Dust Samples	3-11
3.5.2	Scheduling Dust Sampling	3-11

Vasquez Boulevard & I-70
Phase III Field Investigation

3.5.3	Collection of Indoor Dust Samples	3-12
3.5.4	Field Documentation	3-12
3.5.5	Sample Preparation	3-13
3.5.6	Analytical Method Requirements	3-13
3.6	<u>Alley Samples</u>	3-13
3.6.1	Identification and Collection of Alleyway Soil Samples	3-13
3.6.2	Field Documentation	3-15
3.6.3	Sample Preparation	3-15
3.6.4	Analytical Method Requirements	3-18
3.7	<u>Schools and Parks</u>	3-18
3.7.1	Identification and Collection of Soil Samples at Schools and Parks ..	3-18
3.7.2	Field Documentation	3-20
3.7.3	Sample Preparation	3-21
3.7.4	Analytical Method Requirements	3-22
3.8	<u>Sample Identification</u>	3-23
3.9	<u>Sample Handling and Custody Requirements</u>	3-24
3.10	<u>Decontamination Procedures</u>	3-24
3.11	<u>Sample Archives</u>	3-25
3.12	<u>Health and Safety</u>	3-25
3.13	<u>Waste Generation and Management</u>	3-25
4.0	QUALITY ASSURANCE PROJECT PLAN	4-1
4.1	<u>Project Task And Organization (A4)</u>	4-1
4.1.1	Project Task	4-1
4.1.2	Project Organization	4-1
4.2	<u>Problem Definition and Background</u>	4-1
4.3	<u>Project Task Description and Schedule</u>	4-1
4.4	<u>Data Quality Objectives</u>	4-1
4.4.1	Criteria for Measurement Data	4-2
4.5	<u>Special Training Requirements and Certification</u>	4-3
4.6	<u>Documentation and Records</u>	4-4
4.6.1	Field Data	4-4
4.6.2	Laboratory Data	4-4
4.6.3	Data Management	4-7
4.7	<u>Measurement And Data Acquisition</u>	4-7
4.8	<u>Quality Control Requirements</u>	4-7
4.8.1	Field Quality Control Samples	4-7
4.8.2	Laboratory Quality Control Samples	4-9
4.9	<u>Detection Limits</u>	4-10
4.10	<u>Instrument/Equipment Testing, Inspection and Maintenance Requirements</u>	4-12

4.11	<u>Instrument Calibration and Frequency</u>	4-12
4.12	<u>Assessment and Oversight</u>	4-13
4.12.1	Assessment and Response Actions	4-13
4.12.1.1	Audits	4-13
4.12.1.2	Corrective Action Procedures	4-14
4.13	<u>Data Validation And Useability</u>	4-15
4.13.1	Data Review Validation and Verification	4-15
4.13.2	Validation and Verification Methods	4-15
4.14	<u>Final Reporting</u>	4-16
4.15	<u>Reconciliation with Data Quality Objectives</u>	4-16
5.0	DATA MANAGEMENT PLAN	5-1
5.1	<u>DMP Objectives</u>	5-1
5.2	<u>Organizational Relationships</u>	5-1
5.3	<u>Organizational Responsibilities for the Database</u>	5-1
5.4	<u>Data Management Team Responsibilities</u>	5-2
5.5	<u>Forms of Data</u>	5-3
5.5.1	Primary Data	5-4
5.5.2	Secondary Data	5-4
5.6	<u>Data Flow</u>	5-5
5.6.1	Reference Data Sources	5-5
5.6.2	Data Acquisition	5-6
5.6.2.1	Field Sampling	5-6
5.6.2.2	Laboratory Data Entry	5-7
5.7	<u>Database Organization</u>	5-7
5.8	<u>Data Screening, Verification, and Validation</u>	5-9
5.8.1	Data Verification	5-9
5.8.2	Data Validation	5-9
5.8.3	Data Amendment/Correction	5-10
5.9	<u>Records Management</u>	5-12
5.9.1	Short-Term Records Management	5-12
5.9.1.1	Hard copy Data Files	5-12
5.9.1.2	Electronic Data Files	5-12
5.9.2	Long Term Records Management	5-13
6.0	REFERENCES	6-1

APPENDICES

Appendix A	Selection of Chemicals of Potential Human Health Concern at the Vasquez Boulevard & I-70 Site
Appendix B	Site Map Depicting Arsenic Levels across VBI70 for Phases I & II
Appendix C	Phase III Investigation- Rationale for Collecting Surface Soil Samples Only
Appendix D	Screening Level Evaluation of Risks from Acute and Subchronic Exposure to Arsenic in Soil
Appendix E	Monte Carlo Simulations Performed to Support Surface Soil Sampling Strategy
Appendix F	Standard Operating Procedures
Appendix G	Method Detection Limit Study and Proficiency Demonstration
Appendix H	Data Management Plan Additions

FIGURES AND TABLES

Tables

Table 1-1	Past and Proposed Investigations for the VBI70 Site
Table 2-1	List of Schools and Parks
Table 4-1	Project-Required Detection Limits for Phase III Investigations
Table 4-2	Required Quality Control and Recommended Corrective Action for Phase III Investigations

Figures

Figure 1-1	Organizational Chart for the Phase III Activities at the VBI70 Site
Figure 1-2	VBI70 site Boundary for Phase III
Figure 1-3	Vasquez Boulevard & I-70 Phase III Field Investigation Project Schedule
Figure 2-1	Distribution of Arsenic Values at Impacted Properties
Figure 2-2	Probability Plots of Arsenic Distribution at Impacted Properties
Figure 2-3	Probability Plots of Arsenic Distribution for Minimally Impacted Properties
Figure 2-4	Arsenic Levels in Surface Soil at Unimpacted Residences
Figure 3-1	Phase III Sample Flow Chart
Figure 3-2	Proposed Grid Sampling Design for Residential Surface Soil- Step 1
Figure 3-3	Proposed Grid Sampling Design for Residential Surface Soil- Step 2
Figure 3-4	Surface Soil Data Sheet
Figure 3-5	Soil Preparation Flow Chart

Vasquez Boulevard & I-70
Phase III Field Investigation

Figure 3-6	Field Sample Preparation Logbook
Figure 3-7	QC Data Sheet- Blind Soil Field Splits
Figure 3-8	QC Data Sheet- Soil Performance Evaluation Standards
Figure 3-9	QC Data Sheet- Equipment Blank Data Sheet
Figure 3-10	Indoor Dust Scheduling Sheet
Figure 3-11	Indoor Dust Sample Data Sheet
Figure 3-12	Typical Sampling Plan at an Alleyway
Figure 3-13	Alleyway Soil Sample Data Sheet
Figure 3-14	Sample Chain of Custody Record
Figure 3-15	Sample Chain of Custody Record for Field Samples
Figure 3-16	Sample Chain of Custody Record for Samples Submitted to the Contract Laboratory
Figure 5-1	Data Amendment/Correction Form

TABLE OF ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
CAR	Corrective Action Request
CCOD	City and County of Denver
CDPHE	Colorado Department of Public Health and Environment
CLP	Contract Laboratory Program
COC	Chain of Custody
COPC	Chemical of Potential Concern
DCN	Document Control Number
DMP	Data Management Plan
DQA	Data Quality Assessment
DQOs	Data Quality Objectives
FPL	Field Project Leader
FQAC	Field Quality Assurance Coordinator
FSP	Field Sampling Plan
GFAA	Graphite Furnace Atomic Absorption
GLP	Good Laboratory Practices
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Responder
HSO	Health and Safety Officer
ICP	Inductively Coupled Plasma
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
IDL	Instrument Detection Limit
IDW	Investigation Derived Waste
IEUBK	Integrated Exposure Uptake Biokinetic Model
ISSI	ISSI Consulting Group, Inc.
LCS	Laboratory Control Sample
MDL	Method Detection Limit
MK	Morrison Knudsen Corporation
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety & Health Administration
PARCC	Precision, Accuracy, Representativeness, Completeness and Comparability
PDC	Property Data Center, Inc.
PE	Performance Evaluation
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RBC	Risk-Based Concentration
REAC	Response Engineering and Analytical Contract
RME	Reasonable Maximum Exposure

Vasquez Boulevard & I-70
Phase III Field Investigation

RPD	Relative Percent Difference
RPM	Remedial Project Manager
SDMS	Superfund Document Management System
SOPs	Standard Operating Procedures
START	Superfund Technical Assessment and Response Team
TL	Team Leader
UCL	Upper Confidence Limit
USEPA	U.S. Environmental Protection Agency
VBI70	Vasquez Boulevard and Interstate 70
WAM	Work Assignment Manager
XRF	X-ray Fluorescence

1.0 BACKGROUND AND STUDY OBJECTIVES

The U.S. Environmental Protection Agency (USEPA), Region 8, is working in cooperation with the City and County of Denver (CCOD), the Colorado Department of Public Health and Environment (CDPHE), the Agency for Toxic Substances Disease Registry (ATSDR), and representatives of several citizens groups to investigate and remediate environmental contamination that has been discovered at the Vasquez Boulevard and Interstate 70 (VBI70) site, located in Denver, Colorado.

Although substantial data regarding the nature and extent of contamination have been collected at the site (see Section 1.2, below), additional data are required to support reliable risk assessment and remedial risk management decisions. These additional data will be collected during a set of field activities that are referred to as the Phase III Field Investigation. This project plan presents the data quality objectives for the Phase III activities, along with the sampling and analysis design, rationale, and specific quality assurance and quality control activities needed to achieve those data quality objectives.

1.1 Key Personnel

The following key USEPA personnel will serve as contacts and provide technical expertise during implementation of this project plan.

- Bonita Lavelle, USEPA Remedial Project Manager. Ms. Lavelle will be responsible for overall project management, technical oversight and coordination among USEPA and its contractors, the State of Colorado and the City and County of Denver. Ms. Lavelle will be a principal decision-maker for this project.
- Christopher P. Weis Ph.D., USEPA Regional Toxicologist. Dr. Weis will serve as the primary technical contact for this project. He will be responsible for technical oversight and evaluating the human health risk to residents of the VBI70 site. Dr. Weis will be a principal data user and decision-maker for this project.
- Tony Selle, USEPA Data Management and GIS Mapping Specialist. Mr. Selle will provide oversight of data management and GIS mapping activities associated with the Phase III project.
- Ted Fellman, USEPA Community Involvement Specialist. Mr. Fellman will provide community involvement support for all aspects of the VBI70 Phase III field investigation.

Several USEPA contractors will provide technical support to the key USEPA personnel. Figure

1-1 is an organizational chart outlining the key USEPA personnel and its contractors who will participate in operations planned for development, implementation, oversight and interpretation of data generated from the Phase III field investigation.

1.2 Project Background

The VBI70 site is located in the northern section of Denver, Colorado. The study area is bounded on the west by the South Platte River and is approximately bounded on the east by Colorado Boulevard. Northern and southern boundaries for the study area are East 52nd Avenue and Martin Luther King Boulevard, respectively. A small area south of Globeville is also included. Its boundaries are: Interstate 70 on the north, West 39th Avenue on the south, Huron Street to the west, the South Platte River on the east and the Burlington Northern Railroad on the southeast. Refer to Figure 1-2 for a map of the site boundaries. The VBI70 site is comprised mainly of residential neighborhoods, but also includes some areas used for commercial and industrial purposes. Contained within the site boundary are two historic smelters (Omaha-Grant and Argo). One current smelter is located north and west of the site (Globe).

Investigations begun in the vicinity of the Globe Smelter revealed the presence of residential soil contamination with metals associated with historic operations of the smelter. As sampling activities were extended further from the smelter, a number of residential properties with higher than anticipated levels of metals in yard soil were identified. The discovery of these elevated soil levels in residential areas is the basis for establishing the VBI70 site.

A number of investigations have been performed to date at the site, as summarized below:

Table I-1 Past and Proposed Investigations for the VBI70 Site

Title	Description	Dates of Implementation	Reference
Phase 1	Approximately 2500 grab samples from 1200 properties	Spring 1998	UOS 1998a
Phase 2	Surface soil grab samples from 300 additional properties	Summer 1998	UOS 1998b
Removal action	Two 5-point composite samples from 44 properties	Summer/Fall 1998	UOS 1998b
Physico-chemical Characterization of Soils	Comparison of sieved and unsieved soils; Speciation of arsenic and lead; Estimates of bioaccessibility	Summer 1998	ISSI 1998a
Risk-based sampling	High density surface sampling at 8 properties; Relationship between soil and dust; Garden vegetable, paint and tap water analyses; Biomonitoring	Summer/Fall 1998	ISSI 1999b
Pilot Scale Soil Characterization Study	Comparison of chemical and physical characteristics of site soils with proposed source soils and materials	Projected for Summer 1999	ISSI 1999d

Key findings and conclusions from these studies are summarized below:

- The chemicals of principal human health concern are arsenic and lead (see Appendix A).
- The spatial pattern of contaminated properties across neighborhoods appears to be unpredictable, with impacted yards occurring at widely separated locations, often surrounded by non-impacted properties (UOS 1998a, 1998b; see map in Appendix B).

- Within a property that has elevated levels of arsenic, the pattern of contamination is generally wide-spread (covering most of the yard), but concentrations may vary significantly from place to place (ISSI 1999b).
- Contamination is generally highest at the surface, diminishing at depths of 12-24 inches (ISSI 1999b, 1999c [see Appendix C]).
- The chemical form of the arsenic is arsenic trioxide (ISSI 1998b).

Based on these data, USEPA has concluded that concentrations of arsenic and, to a lesser extent, lead in surface soil may be of health concern to some (but not all) area residents. Because of this concern, USEPA proposed this site for inclusion on the National Priorities List in January, 1999.

1.3 Study Objectives

USEPA's overall objective is to collect sufficient data to adequately characterize the nature and extent of soil contamination at this site, and to support reliable risk assessment calculations and risk management decisions at the site regarding the need to remediate residential soil. Phase III comprises a set of field activities that specifically targets four data gaps associated with exposure of residents to contaminated soil:

1. Location of Residences with Contaminated Soil

Because of the apparent lack of spatial pattern in the location of contaminated residences, a yard-by-yard sampling effort is required to locate and identify all properties with elevated levels of arsenic and lead. Thus, the principal study objective of this project is:

Collect sufficient soil data from each residential property within the site boundaries to support reliable exposure and risk calculations at each property, including an evaluation of both short-term and long-term risks.

2. Relation Between Contaminant Levels in Residential Yard Soil and Indoor Dust

Contaminants in outdoor soil are able to enter homes through airborne and direct transport pathways, and can contribute to contamination of indoor dust on floors, tables, counter tops, etc. Data collected to date suggest that indoor dust contamination at residences may not be extensive at this site (ISSI 1999b), but the data are too limited to draw firm conclusions regarding the importance of the soil-to-dust contaminant transport. Consequently, the objective of this

component of the Phase III project is to:

Collect sufficient numbers of paired soil-dust samples to reliably quantify the average relationship between outdoor yard soil contamination and indoor dust contamination in area residences.

3. Characterization of Soil in Alleyways

Unpaved alleyways exist at some locations in the study area. If the soil in these alleyways is contaminated with arsenic and/or lead, this could be a source of concern for nearby residents. Currently, no data exist on contaminant levels in alleyways within the study area. Therefore, the objective of this part of the Phase III program is to:

Collect sufficient samples from selected unpaved alleyways to determine whether levels of arsenic and/or lead in alleyway soil are likely to be of potential health concern to area residents, and if so, to provide initial information that will help determine the likely source and spatial pattern of alleyway contamination.

4. Characterization of Soil at Schools and Parks

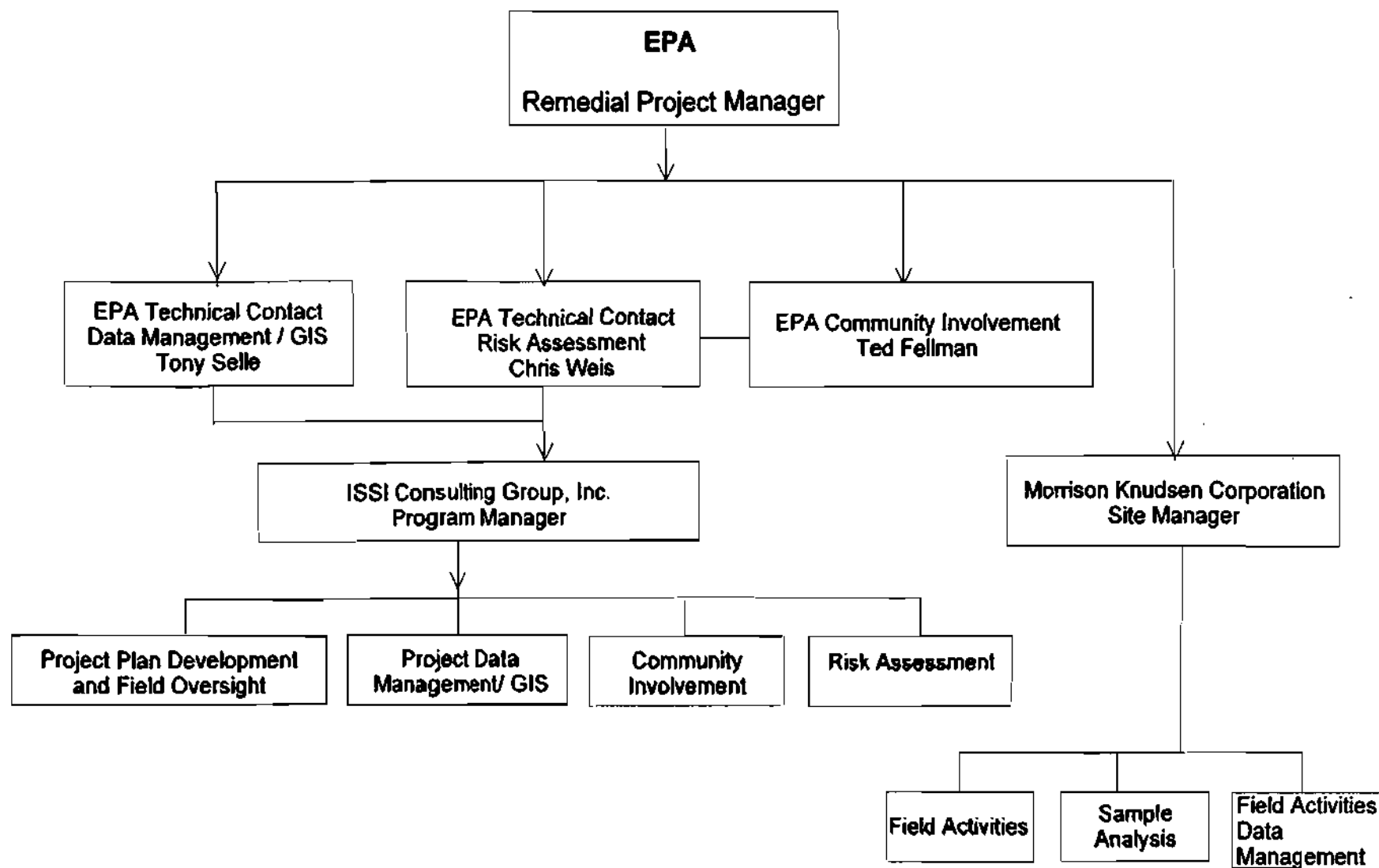
Area children are likely to be exposed not only at their residences but also at neighborhood schools and parks. Available data (UOS 1998a, 1998b) suggest that contamination at these locations is not of concern, but not all locations have been sampled. Therefore, the objective of this component of the Phase III project is to:

Collect sufficient samples of surface soil from un-tested schools and parks to support reliable exposure and risk calculations at each location, including an evaluation of both short-term and long-term risks.

1.4 **Project Description**

These objectives will be accomplished by collection of environmental samples during field work to be completed in the summer of 1999. This work will be performed by Morrison Knudsen Corporation (MK), with planning and oversight provided by ISSI Consulting Group, Inc. (ISSI). All work will be conducted in accord with the detailed specifications contained within this project plan. Figure 1-3 provides a schedule of planned activities for the Phase III Field Investigation.

Figure 1-1: Organizational Chart for the Phase III Activities at the VBI70 Site



Color Map(s)

The following pages
contain color that does
not appear in the
scanned images.

To view the actual images, please
contact the Superfund Records
Center at (303) 312-6473.

Figure 1-2

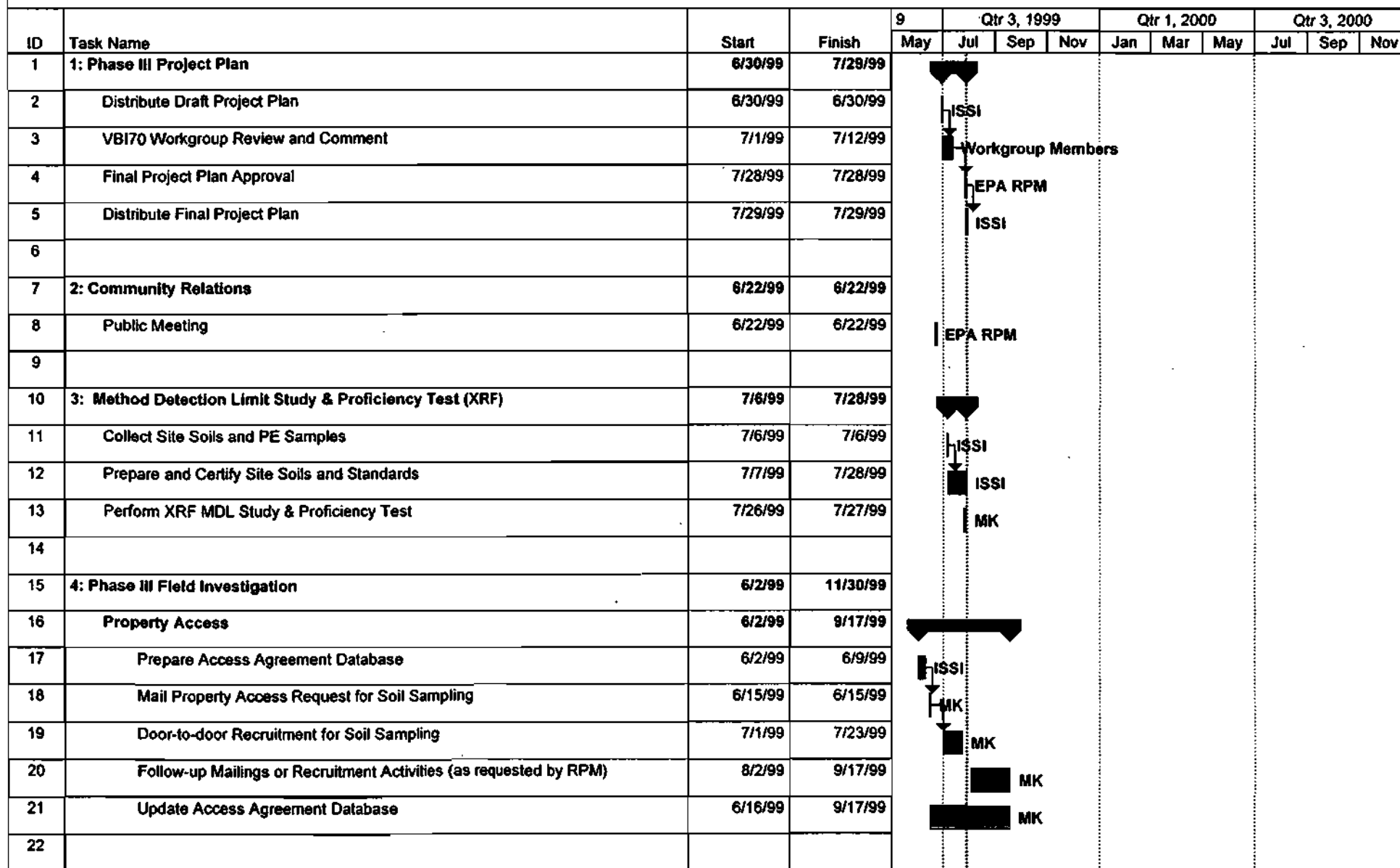
VR170 Site Boundary for Phase III

- Site Boundary (as of July, 1999)
- Phase I Remedial Soil Sampling Locations
- Phase II Remedial Soil Sampling Locations

Source: Environmental Sciences and Technology, Inc. (ESTI)



Figure 1-3
Vasquez Boulevard & I-70
PHASE III FIELD INVESTIGATION :
Project Schedule



2.0 DATA QUALITY OBJECTIVES AND STUDY DESIGN

Data Quality Objectives (DQOs) are statements that define the type, quality, quantity, purpose and use of data to be collected. The design of a study is closely tied to the data quality objectives, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected, the chemical analyses to be performed, etc.

USEPA has published a number of guidance documents on the DQO process (USEPA 1994a, 1994a, 1996), and this project plan has been developed in accord with that guidance. In brief, the DQO process follows a seven-step procedure, as follows:

1. State the problem that the study is designed to address
2. Identify the decisions to be made with the data obtained
3. Identify the types of data inputs needed to make the decision
4. Define the bounds (in space and time) of the study
5. Define the decision rule which will be used to make decisions
6. Define the acceptable limits on decision errors
7. Optimize the design for obtaining data in an iterative fashion using information and DQOs identified in Steps 1-6

Following these seven steps helps ensure that the project plan is carefully thought out and that the data collected will provide sufficient information to support the key decisions which must be made. The following sections summarize the application of the DQO process to the design of each of the four component parts of the VBI70 Phase III included in this project plan.

2.1 Residential Soil Sampling

2.1.1 Data Quality Objectives

State the Problem

As noted previously, data from previous investigations at the site suggest that contaminated residential properties exist in an unpredictable pattern, and that the location of a contaminated property cannot be identified based on data from other nearby residences. Thus, the basic problem is to develop a method for identifying all individual properties that have contaminant levels above a level of health concern, and to obtain data from these properties that will allow evaluation of the health risks from direct and indirect contact with the soil.

Each individual property within the study area will be evaluated to determine whether the concentrations of contaminants are either a) acceptable, or b) potentially unacceptable. These risk-based decisions will, in turn, form an important input to risk management decision-making at the site.

Types of Input Needed

The information needed to make risk-based decisions at a residential property is reliable data on the concentration values in soil at the residence. The key statistic is the arithmetic mean concentration within that property. However, because the true mean concentration within a property cannot be derived with certainty from a limited set of samples from the residence, USEPA specifies that the decision for most chemicals (including arsenic) will be based on the 95% upper confidence limit of the mean (95% UCL) (USEPA 1992a). This, in turn, requires information on the inter-sample variability, and on the shape of the distribution of grab samples from a property (e.g., normal, lognormal).

Bounds of the Study

Spatial Bounds

All residential properties within the site boundary that have not been sampled to date will be sampled during Phase III, if authorization for access is granted by the owner. It is estimated that there are approximately 3000 such residential properties. Residential properties that have been sampled previously will not be re-sampled during Phase III unless it is determined that the existing data for a property are not adequate to support a reliable risk assessment and remedial decisions. This determination will be presented in a separate document.

Temporal Bounds

All data will be collected during the summer and fall of 1999. However, because concentration values in soil are unlikely to vary significantly over time, the precise time period when collection occurs is not important. Results will be applied to current and future exposure conditions.

Decision Rule

Available data indicate that the basic unit of contamination is an individual property (ISSI 1999b). Therefore, each property will be evaluated on an individual basis. Conceptually, the classification of a property is achieved by performing exposure and risk calculations in accord with standard approaches and method specified by USEPA. For convenience, this approach may

be simplified by calculating the maximum concentration value that yields an acceptable risk, and identifying this value as the Risk-Based Concentration (RBC). Then, each property can be classified simply by comparing the appropriate site statistic to the RBC. For arsenic, the risk calculation is based on the 95% UCL for the property, so the classification is achieved by comparing the 95% upper confidence limit of the arithmetic mean (UCL) for the property to the RBC for arsenic. Conceptually, three different RBCs are relevant: acute, subchronic and chronic.

However, as demonstrated in Appendix D, any property that fails the comparison for the acute or sub-chronic RBC is also expected to fail the comparison for the chronic RBC. Nevertheless, all properties will be evaluated using a three-step test to identify a property that is of potential concern from arsenic for acute, subchronic or chronic exposure. The property will be determined acceptable only if all three tests are acceptable (see table below). In the case of lead, the forward-going risk calculation is based on the arithmetic mean of lead concentrations within the property, so classification is achieved by comparing the arithmetic mean soil concentration of the three composite samples to an appropriate site-specific Risk-Based Concentration (RBC) for lead.

Chemical	Test Result	Decision
Arsenic	Three-Step Test	
Test I (chronic)	$95\% \text{ UCL} \leq \text{RBC}_c$ $95\% \text{ UCL} > \text{RBC}_c$	Acceptable Potentially unacceptable
Test II (subchronic)	$C_{\max} \leq \text{MTCV}_{sc}$ $C_{\max} > \text{MTCV}_{sc}$	Acceptable Potentially unacceptable
Test III (acute)	$C_{\max} \leq \text{MTCV}_a$ $C_{\max} > \text{MTCV}_a$	Acceptable Potentially unacceptable
Lead	$\text{Mean} \leq \text{RBC}_{pb}$ $\text{Mean} > \text{RBC}_{pb}$	Acceptable Potentially unacceptable

RBC_c - RBC for chronic exposure

C_{\max} - Maximum concentration at a single property in a composite of size 10

MTCV_{sc} - Minimum Theoretical Composite Value for subchronic exposure

MTCV_a - Minimum Theoretical Composite Value for acute exposure

RBC_{pb} - site-specific RBC for lead

The RBC for both arsenic and lead will be developed during the feasibility study for the site, after finalization of the human health risk assessment. The RBCs will be designed to protect an individual with Reasonable Maximum Exposure (RME), and will be calculated using all of the same exposure and toxicity values developed for use in the risk assessment. This will include use of all reliable site-specific data available, and may include both deterministic risk assessment approaches and/or probabilistic approaches, as needed to adequately characterize the variability

and uncertainty in risk to humans at the site. That is, a range of potential RBCs may be developed, allowing for risk management judgement in selection of an appropriate decision criterion, in accord with the nine criteria described in the National Contingency Plan (40 Code of Federal Regulations [CFR] Part 300).

Acceptable Limits on Decision Errors

In accord with standard risk-based decision-making at Superfund sites, a property will be assumed to be contaminated unless there is at least 95% confidence that the property is actually safe (i.e., $\alpha = 0.05$) (USEPA 1992b).

For arsenic, this is achieved by using the 95% UCL of the mean concentration at the property as the basis for decision making. That is, if the 95% UCL is less than the RBC, there is at least 95% confidence that the true mean value for the property is below the RBC and that risks are within acceptable limits. However, use of the 95% UCL for arsenic means that some properties that are actually safe may be declared to be unacceptable. Generally, the frequency of this type of error should be no more than 20% (USEPA 1992b). For this project, the goal is to ensure that the frequency of this type of decision error is as low as can be achieved with the available sampling and analysis budget. Once properties that are potentially unacceptable are identified, USEPA may choose to collect additional surface soil samples to minimize this type of error.

For lead, 95% confidence that the property is safe is achieved by use of USEPA's Integrated Exposure Uptake Biokinetic (IEUBK) model or other appropriate mathematical model that describes the probability that an individual exposed to a specified set of environmental lead levels will have a blood lead value that is above a level of health concern (10 ug/dL). The RBC is defined as the soil concentration such that the probability of an individual having a value above 10 ug/dL is no more than 5% (USEPA 1994c). It should be noted that the IEUBK model accounts for all sources of lead exposure, not just soil and dust.

2.1.2 Study Design

Based on the data quality objectives outlined above, the key design elements of the soil sampling component of the Phase III project are as summarized below.

Sampling Depth

Available data on COPC levels in residential soils are sufficient to establish that when contamination is present in a yard, it is mainly surficial (0-2 inches), and that concentrations of contaminants in subsurface soil tend to be lower than in the surface soil (ISSI 1999c; see Appendix C). Thus, this project will seek to characterize only surficial soil in residential yards. Once properties that are potentially unacceptable are identified, USEPA may choose to collect

subsurface soil samples to help determine the appropriate depth of remediation, as appropriate.

Calculation of the 95% UCL

Currently, USEPA has established default methods for calculating the 95% UCL for distributions that are either normal or lognormal (USEPA 1992a):

Normal:

$$UCL = m + t_{1-\alpha, n-1} * \frac{s}{\sqrt{n}} \quad (1)$$

where:

m	=	arithmetic mean of the data
s	=	standard deviation of the data
n	=	number of samples
$t_{1-\alpha, n-1}$	=	t-statistic for the (1- α) percentile of the t distribution with n-1 degrees of freedom

Lognormal:

$$UCL = \exp\left(m_i + 0.5s_i^2 + \frac{s_i H}{\sqrt{n-1}}\right) \quad (2)$$

where:

m_i	=	mean of the log-transformed data
s_i	=	standard deviation of the log-transformed data
n	=	number of samples
H	=	H-statistic from table in USEPA (1992a)

Equations for calculating the 95% UCL of the mean for distributions other than the normal and the lognormal are not readily available.

At this site, data from eight residential properties that have been intensively sampled (ISSI 1999b) suggest the distribution of arsenic values within a residential property tends to be right-skewed, at least for properties where concentration values are substantially higher than average (see Figure 2-1). This indicates that a log-normal distribution might be appropriate for characterizing the distributions at such locations. However, tests of the distribution at these impacted properties reveal that the data are not well characterized by a lognormal (or a normal) distribution (Figure 2-2). The distribution of values at properties that are not impacted or minimally impacted (mean concentration = 40-70 mg/kg) appears to be more nearly normal

(Figure 2-3), but are still skewed at the low end by the presence of multiple values below the detection limit. Because the distributions are not well characterized as either normal or lognormal, use of either equation 1 or equation 2 as the basis for calculating the 95% UCL based on a series of grab samples might yield results that are not accurate.

One way to minimize problems associated with calculating the 95% UCL of the mean for non-standard distributions is compositing. This is because, regardless of the shape of the parent distribution, the distribution of the values of composite samples will approach a normal distribution if the number of sub-samples is sufficiently large and the sub-samples are thoroughly mixed, allowing use of equation 1 for calculation of the UCL of the mean at a property. In addition, the variability between composite samples is less than between grab samples, so uncertainty in the mean of composite samples is usually less than for an equal number of grab samples. For these reasons, the Phase III soil sampling study will utilize compositing of grab samples collected within a property.

Number of Grab Samples per Composite

In order to estimate the number of grab samples per composite needed to reduce intra-composite variability and to ensure that distribution of composites is approximately normal, Monte Carlo simulations were performed using site-specific data from properties that had been intensively sampled (140-160 data points per property) (ISSI 1999b). In these simulations, grab samples of size j ($j = 5, 10, 15, 25, 30, 50$ grabs per composite) were repeatedly drawn, and the composite mean was calculated as the mean of the grab samples. Then the distribution of the composite values was tested for normality. The results are presented in Appendix E. Based on these tests, a set of 10 sub-samples was found to be adequate to ensure that the distribution of the composites drawn from minimally impacted properties (sample mean = 40-70 mg/kg) will be approximately normal.

At the intensively sampled properties that were clearly impacted (sample mean = 390-2370 mg/kg), the number of grab samples per composite needed to ensure that the distribution of composites is approximately normal is about 15-25. Thus, the distribution of the 10-point composite samples from such a property is likely to be somewhat right-skewed. For right skewed distributions, the median is less than the mean and therefore a single 10-point composite sample is more likely to be below the true mean than it is above the true mean. However, some 10-point composite sample values may be raised by very high although infrequent values and the mean of the three 10-point composite samples should, therefore, approach the true mean and use of equation 1 to calculate the 95% UCL could underestimate the true UCL. At such a location, it is expected that the identification of the property as potentially unacceptable can readily be made based on a comparison of the sample mean to the RBC. That is, if the sample mean is above the RBC, the property may be classified as potentially unacceptable without regard to the value of the UCL. Therefore, the possibility of incorrectly identifying the property as acceptable when it

is really not acceptable is very small.

Number of Composites per Property

The number of composites per yard depends on the acceptable probability of making a Type I (false positive) error. This is the case when a property is incorrectly identified as being above a level of concern when it is actually below a level of concern. In general, as the number of composites increases, the chances of making this type of error decreases. However, the exact number depends on the expected difference between the RBC and the typical level in un-impacted properties. That is, the wider the difference between the mean value at un-impacted properties and the RBC, the fewer samples that are needed to establish that the UCL for an un-impacted property is below the RBC. As noted above, EPA guidance (USEPA 1992b) recommends that the value be no more than 20%, and the goal of the study is to reduce the Type I error rate to the maximum extent that available resources will permit.

In order to investigate the relationship between Type I error rate and the number of composites at this site, a Monte Carlo simulation was performed based on an assumed distribution of arsenic levels in un-impacted properties. This distribution was based on available data on arsenic levels in residential surface soil samples collected in the vicinity of the Globe plant (see Figure 2-4). Each data point represents the measured arsenic value in a four-point composite from a residential property. Values higher than 70 mg/kg were assumed to represent potentially impacted properties, and were not considered in the approximation of the background distribution. Even though these data are from outside the study area for the Phase 3 project, the distribution of values is judged to be reasonably predictive for those that are expected to occur within the study area. Based on these data, the distribution of true property means at an un-impacted property was modeled as:

$$\text{Background} = \text{LN}(21,13)$$

where:

LN(21, 13) = lognormal distribution with parameters 21 and 13

21 = mean of the (untransformed) data

13 = standard deviation of the (untransformed) data

From this distribution, a series of random "true means" were selected, each representing a randomly selected background property. The inter-grab sample variability at each property with "true mean" m was simulated based on the observed range of inter-grab-sample variability at the eight properties that had been intensively sampled. At these properties, the coefficient of variation ($CV = \text{standard deviation}/\text{mean}$) ranged from about 0.8 to 1.2. Because this range was based on only 8 properties, a slightly wider range of variability ($CV = 0.7$ to 1.3) was assumed.

Based on this, the standard deviation at a simulated property was simulated as:

$$s = m \cdot CV$$
$$CV = TRI(0.7, 1.0, 1.3)$$

where:

TRI(0.7, 1.0, 1.3) = triangular distribution with parameters 0.7, 1.0, 1.3

0.7 = minimum value

1.0 = mode (most likely value)

1.3 = maximum value

For each simulated "true mean" and "true standard deviation", a series of grab samples were selected at random, and combined into n composites of j grab samples per composite. From these, the inter-composite means and standard deviation were calculated and used to calculate the 95% UCL using equation 1 (above). The Type I error rate was assessed by counting the number of properties where the "true mean" was less than the RBC but the 95% UCL was above the RBC.

Because a site-specific RBC has not been derived, it was necessary to assume a value for the purposes of planning the design of Phase III. For arsenic, a value of 70 mg/kg was adopted.

Note that the use of this value for planning Phase III is not equivalent to a decision that this value is actually appropriate. The actual level of human health risk at 70 mg/kg has not been determined, and the final RBC for soil will be developed only after performance of the site-specific risk assessment, using all available site-specific data, and the final value may be higher or lower than 70 mg/kg.

Employing an assumed RBC of 70 mg/kg and the estimated background distribution described above, and employing a grab sample size of 10, the simulated Type I error rates are as shown below:

Number of Composites	Estimated Type I Error rate
2	15%
3	4.1%
4	2.6%
6	1.5%

As seen, if only 2 composites were used, there would be a relatively high probability (about 15%) of declaring a property to be potentially unacceptable when it was actually acceptable. Use of three composites reduces the rate to about 4%, and this error rate can be reduced further by going to 4 or 6 composites. Although a Type I error rate of 4% is very good by most standards, because of the large number of properties which must be evaluated at this site, even a rate this low results in a large number of errors (up to 120 residences).

Based on these findings, a phased approach to sampling and reducing Type I errors was developed. That is, samples collected at each property tested in Phase III will include three composites of 10 grab samples each. All properties whose 95% UCL exceeds the RBC will be considered potentially unacceptable. However, because of the possibility of a Type I error, EPA may consider performing further sampling activities at such locations (especially those where the sample mean is close to or below the RBC) in order to determine whether the property actually does exceed an acceptable level.

Sampling Location

The 30 sub-sampling locations within a yard will be selected in a semi-systematic fashion, as detailed in the Field Sampling Plan (FSP) (Section 3.0).

Sample Preparation

Sub-samples collected at a property will be combined into 3 composite samples in the field, using the standard operating procedures (SOP) provided in Appendix F. These composite samples will be transported to the laboratory, where each will be dried and sieved using a 2 mm screen (#10 sieve). The purpose of this sieving is to remove all large objects and debris such as twigs, clumps of grass, etc. Currently, EPA Region 8 recommends that soil samples used for human health risk assessment purposes be sieved a second time in order to isolate the very fine fraction (less than 250 μm) from the larger soil particles. This is because it is assumed that human exposure is more likely to be to the fine particles than the coarse particles. However, in this case, a previous study at the site (ISSI 1998b) has demonstrated that there is very little difference in contaminant concentration between the fine fraction (< 250 μm) and the bulk fraction (< 2 mm). Therefore, sieving to isolate the fines is not needed for all samples. However, sieving and analysis of the fine fraction will be performed on a selected subset of the soil samples in order to confirm the expectation that concentration values are not higher in fine particles than in bulk soil.

Analyte List

As noted above, data currently available establish that the chemicals of potential concern

(COPCs) at this site are arsenic and lead (ISSI 1999a; see Appendix A). Other chemicals either are not of health concern, or contribute a risk much lower than that contributed by arsenic. Thus, the analyte list for all samples collected during this project is:

Arsenic
Lead

Analytical Method and Detection Limits

Lead and arsenic will be measured in soil samples by fixed-base x-ray fluorescence (XRF). Although health-based criteria have not yet been formally established at this site for either lead or arsenic, experience at other sites has shown that arsenic must be measured with a practical quantitation limit no higher than about 30 mg/kg, and lead should be measured with a practical quantitation limit no higher than about 150 mg/kg. Based on this, acceptable method detection limits at this site will be no higher than:

Arsenic: 10 mg/kg
Lead: 50 mg/kg

Data Interpretation/Data Use

Surface soil data generated during this part of the Phase III project will form the basis for evaluating the potential human health risks at each property. This will be done following standard methods established by the USEPA for assessing health risks to residents from arsenic and lead. That is, a property will be declared acceptable if the three-step test for arsenic is declared acceptable [(1): 95% UCL is less than the RBC; (2): C_{max} is less than the MTCV for subchronic exposure; and (3): C_{max} is less than the MTCV for acute exposure] AND the arithmetic mean for lead is less than the RBC for lead. If any of the three tests for arsenic are declared potentially unacceptable or the mean concentration for lead exceeds the corresponding RBC, the property will be considered to have potentially unacceptable human health risk. If a property is identified as potentially unacceptable, USEPA may either remediate the property in its entirety, or may perform further sampling to determine with greater confidence a) whether remediation is actually needed, and if so, b) which part or parts of the yard require remediation.

2.2 Indoor Dust Sampling

2.2.1 Data Quality Objectives

State the Problem

Contaminants in outdoor soil are able to enter homes through airborne and direct transport

pathways, and can contribute to contamination of indoor dust on floors, tables, counter tops, etc. Currently, USEPA assumes that about 55% of the total exposure to contaminants in soil occurs indirectly via ingestion of indoor dust (USEPA 1994b). Thus, reliable estimates of the indoor dust concentration are an important part of the risk assessment process.

Collection of indoor dust samples, however, is difficult and costly. Therefore, the problem is to establish a scientifically sound approach for estimating the expected indoor dust concentrations at a residence based on measurements of contaminant levels in yard soil for that residence.

Decisions to Be Made

The decision to be made is the value to be assumed for the concentration of each chemical of potential concern in indoor dust, given only the concentration of that chemical in yard soil.

Types of Input Needed

The basic approach for estimating dust concentrations at locations where they have not been measured is to obtain a robust set of "paired" data on contaminant levels in yard soil and indoor dust (i.e., both measurements are from the same property). These data are fit to an appropriate equation using computer-based regression techniques, and the resultant equation is used to impute dust concentrations from measured soil concentrations. At other sites, a simple linear model has generally proved to be adequate:

$$C_{\text{dust}} = D_0 + k * C_{\text{soil}}$$

Thus, the inputs needed to establish the parameters of this relationship are an adequate set of paired measurements of COPC levels in indoor dust and outdoor yard soil at multiple residences within the site boundaries.

Bounds of the Study

Any residence for which a reliable soil sample is available is a candidate for collection of a paired indoor dust sample. As discussed below, locations for collection of indoor dust will be stratified to achieve spatial representativeness (across neighborhoods), and will also be stratified to ensure a wide range in soil sample concentrations.

Decision Rule

The concentration of a COPC in indoor dust at a residence will be estimated from the measured value in soil using the best fit equation through the paired soil-dust data.

Acceptable Limits on Decision Errors

If the value of the concentration of a COPC is not known with certainty in either the soil sample or the dust sample, linear regression analysis of the paired samples will tend to underestimate the true slope of the correlation. Thus, the goal is to ensure that the measured values of the concentration in soil and the concentration in dust are sufficiently accurate that the slope of the regression line is within 30% of the true slope.

2.2.2 Study Design

Based on the data quality objectives outlined above, the key design elements of the indoor dust sampling component of the Phase III project are as summarized below.

Sample Number

Data obtained from previous sampling programs at VBI70 were used to estimate the total number of samples required for the study. Based on a soil sample that is a composite of 10 sub-samples, Monte Carlo simulation indicated that reliable results could be obtained if the number of paired soil-dust samples is approximately 50-100. Thus, this part of the Phase III project will collect an indoor dust sample from no fewer than 60 and no more than 90 residences where composite soil samples have been collected.

Sample Locations

Indoor dust sampling locations will be selected to ensure a representative spatial coverage of the site, as well as a suitable range of lead and arsenic concentrations in soil. That is, approximately 10-15 sampling locations will be selected from each of the six neighborhoods which comprise the study area, and locations will be selected to include approximately equal numbers of samples from properties with soil arsenic concentrations in each of the following ranges: low (less than 100 mg/kg), medium (100-300 mg/kg), and high (greater than 300 mg/kg). Special effort will be made to include properties with the highest contamination levels (e.g., greater than 500 mg/kg), since these locations are especially helpful in defining the relationship between soil and dust.

Sample Collection

One composite dust sample consisting of 8-14 sub-samples will be collected at each residence selected for sampling. This composite will be collected using a high-volume vacuum collection device. The sub-samples will be collected in rooms or other living areas ("living spaces") where the residents are most likely exposed including: bedrooms, family and/or television rooms, kitchens, hallways and entryways. In order to standardize the collection process, dust samples will be collected using a template to define the area to be vacuumed. In most cases, 2 templates

will be collected per living space. Thus, the total number of templates collected within a residence will be dependent upon the number of living spaces available. For example, if there are 2 bedrooms, a family room, a kitchen and a hallway, and if two sub-samples are collected in each living space, there would be a total of 10 sub-samples in the composite for that residence. In the case where a residence has more than 10 living spaces, only 1 template per living space will be collected. This approach is recommended so that 20-30 sub-samples are not collected for a large residence. Details on the locations within each living space where dust will be collected are provided in the FSP (Section 3.0).

The total mass of dust collected in the composite sample must be at least one gram. If a 1-gram sample is not collected using the protocol above, additional templates should be collected from appropriate living areas until sufficient mass is collected.

Sample Preparation

Each dust sample will be sieved as detailed in SOP ISSI-VBI70-04 in order to remove non-dust components.

Sample Analysis

The analyte list for indoor dust is the same as selected for soil (arsenic, lead).

Because the mass of dust collected from a residence is often too low to support reliable quantification by XRF techniques, samples will be sieved to removed lint and/or hair, prepared using a nitric acid digestion, and analyzed using standard USEPA protocols via either graphite furnace atomic absorption (GFAA) or Inductively Coupled Plasma/Mass Spectrometry (ICP/MS). Practical quantitation limits for this method are approximately:

$$\begin{aligned}\text{As} &= 5.0 \text{ mg/kg} \\ \text{Pb} &= 1.0 \text{ mg/kg}\end{aligned}$$

Data Interpretation/Data Use

Data collected from this study will be used to quantify the average (site-wide) relationship between outdoor yard soil contamination and indoor dust contamination. This will be done by preparing a graph of the paired soil-dust concentrations for each analyte, and finding the best-fit regression equation through the data. At other sites, a simple linear model has proved to be

appropriate:

$$C_{\text{dust}} = D_0 + k * C_{\text{soil}}$$

The value of D_0 indicates the average “background” level of analyte expected in indoor dust, and k is the average increment in indoor dust concentration per unit concentration in outdoor soil. This equation can be used to help increase the accuracy of the human health risk assessment at the site, as well as increase the accuracy of the site-specific RBC for soil.

In the event that one or more dust samples are determined to have interior contaminant levels which are substantially higher (more than 5-fold) than the mean concentration in outdoor yard soil, and are in a range of potential health concern, USEPA may re-visit that property and collect additional samples in order to a) confirm that the original data are accurate, and if so, b) identify likely non-yard sources of dust contamination. If non-yard sources of interior dust contamination are identified at one or more residences, and if the levels are in a range of potential health concern, these locations will be referred to appropriate agencies for investigation and follow-up.

2.3 Alley Soil Pilot Study

2.3.1 Data Quality Objectives

State the Problem

Unpaved alleyways (e.g., dirt or gravel roads) exist at a number of locations in the study area, and vehicular traffic on the alleyways often raises substantial amounts of dust. If these alleyways are contaminated with arsenic and/or lead, this airborne transport of dust could be a source of concern for nearby residents, for several reasons:

- 1) Direct inhalation of the dust
- 2) Contamination of otherwise uncontaminated yard soils
- 3) Contamination of indoor dust

Of these three pathways, contamination of indoor dust is likely to be the greatest reason for concern.

Decisions to Be Made

The decision to be made with the data collected during this pilot study is:

Is there evidence that alleyways contain levels of contaminants that are of potential human health concern?

If so, further studies will be planned to define the nature and extent of alleyway contamination. If not, exposure from alleyways will not be addressed further.

Types of Input Needed

The input needed to make this decision is data on the concentrations of chemicals of concern in alleyway soils at multiple locations within the site.

Bounds of the Study

Any unpaved alley within the boundary of the site is a candidate location for collecting alley soil samples during the pilot project.

Decision Rule

There is no standard risk-based decision rule established by USEPA for evaluation of contamination levels in alleyways, since the magnitude of human exposure from soil in such locations is not known. Based on the assumption that exposure in an alleyway is likely to be substantially less than at a person's house, any alley where the 95% UCL for arsenic and the mean concentration for lead are less than or equal to the corresponding RBCs for a residential yard will be considered to be clearly acceptable.

If any alleyway is located where the 95% UCL for arsenic or the mean for lead exceeds the RBC for residential yards, USEPA will perform a more detailed study to characterize the nature and extent of the contamination, and to estimate the risk to area residents.

Acceptable Limits on Decision Errors

Because the ally sampling plan is a pilot study and is not intended to make final risk-based decisions, no formal quantitative limits on decision errors are required. However, because the screening-level assessment will be based on a comparison of the 95% UCL to the residential soil RBC, it is important that the 95% UCL not be unnecessarily elevated, since this could lead to a high frequency of declaring an alleyway to be potentially unsafe when it really is safe. Therefore, the goal of this phase of the study is that the 95% UCL be within 40% of the sample mean.

2.3.2 Study Design

Based on the data quality objectives outlined above, the key design elements of the alley soil pilot study component of the Phase III project are as summarized below.

Sample Number

Calculation of the number of samples needed to ensure that the 95% UCL is within 40% of the sample mean requires knowledge of the expected variability between samples from alleyways. Since no such samples exist at present, the value of n cannot be calculated with confidence. However, based on experience at other sites, it is expected that a data set of 20-30 samples from an alley will be sufficient to achieve this goal.

Sample Locations

Alleys to be sampled will be selected based on the results of the residential soil sampling project. Preference will be given to alleys that are adjoined by multiple properties that have been sampled, and where at least one of the properties is clearly impacted by arsenic (e.g., mean value is greater than 200 mg/kg). A total of 4-6 such alleys will be sought, each consisting of one city block.

The location of samples within each alley will be defined by a systematic grid laid out over the surface of the alley, as detailed in the FSP (Section 3.0).

Sample Collection

Soil samples from each sampling location will be collected using a procedure similar to that for yard soil, except that compositing of samples will not be performed. This is so that if there are isolated areas of contamination in the alley, the presence of these locations can be observed.

Sample Preparation

Soil samples from alleyways will be dried and sieved through a 2 mm screen (#10 sieve).

Sample Analysis

All alley soil samples will be analyzed using the same method as used for yard soil samples.

Data Interpretation/Data Use

The data from this pilot study will be used to judge if there is a basis to be concerned over chemical contamination of soils in alleyways. This will be done by comparing the 95% UCL of the mean for arsenic and the mean for lead to RBCs based on residential exposures. If the values are below the RBCs, it will be concluded that alley soils are not of concern. If one or both chemicals exceeds its RBC, further studies will be performed to characterize the nature and extent of alleyway contamination and the magnitude of the human health risk, as needed.

2.4 Characterization of Schools and Parks

2.4.1 Data Quality Objectives

State the Problem

Area residents (especially children) may be exposed to contaminants not only at their residence, but also at neighborhood schools and parks. Available data collected to date suggest that neither schools nor parks are a source of concern (UOS 1998a, 1998b), but some locations have not yet been sampled.

Decisions to Be Made

Each school yard and park within the study area will be evaluated to determine whether the concentrations of contaminants are either a) acceptable, or b) potentially unacceptable. These risk-based decisions will, in turn, form an important input to risk management decision-making at the site.

Types of Input Needed

Data required to evaluate each school yard and park are reliable and accurate measurements of the concentration of each chemical of potential concern in representative surface soil samples from each location.

Bounds of the Study

Table 2-1 lists all schools and parks within the study area. Those that have been studied previously will not be re-investigated during Phase III. Locations that have not been studied to date and which will be sampled during Phase III are indicated in the Table.

Decision Rule

Each schoolyard and park will be evaluated using a decision rule analogous to that for residential properties:

Chemical	Test Result	Decision
Arsenic	Three-Step Test	
Test I (chronic)	95% UCL \leq RBC _c 95% UCL $>$ RBC _c	Acceptable Potentially unacceptable
Test II (subchronic)	C _{max} \leq MTCV _{sc} C _{max} $>$ MTCV _{sc}	Acceptable Potentially unacceptable
Test III (acute)	C _{max} \leq MTCV _a C _{max} $>$ MTCV _a	Acceptable Potentially unacceptable
Lead	Mean \leq RBC _{pb} Mean $>$ RBC _{pb}	Acceptable Potentially unacceptable

RBC_c - RBC for chronic exposure

C_{max} - Maximum concentration at a single property in a composite of size 10

MTCV_{sc} - Minimum Theoretical Composite Value for subchronic exposure

MTCV_a - Minimum Theoretical Composite Value for acute exposure

RBC_{pb} - site-specific RBC for lead

Note that, because of differences in duration and frequency of exposure, the RBC for arsenic and/or lead may not be identical at schools, parks and residences. Each type of RBC will be developed during the feasibility study for the site, after finalization of the human health risk assessment. The final RBCs will be calculated using all of the same exposure and toxicity values developed for use in the risk assessment. This will include use of all reliable site-specific data available, and may include both deterministic risk assessment approaches and/or probabilistic approaches, as needed to adequately characterize the variability and uncertainty in risk to humans at the site. That is, a range of potential RBCs may be developed, allowing for risk management judgement in selection of an appropriate decision criterion.

Acceptable Limits on Decision Errors

The maximum acceptable probability that a school yard or park will be declared acceptable when it really is not acceptable is 5%. As above, the probability of declaring the property potentially unacceptable when it really is acceptable will be reduced to the lowest level possible with the available sampling and analysis budget.

2.4.2 Study Design

Based on the data quality objectives outlined above, the key design elements of the school/park sampling component of the Phase III project are as summarized below.

Sampling Depth

All samples will be collected from the 0-2 inch depth interval.

Number and Location of sample Collection

The number and location of sample collection at each school and park included in Phase III will be detailed in an addendum to the FSP (Section 3.0), after survey of each target property.

Sample Preparation and Analysis

All samples will be prepared and analyzed in the same way employed for residential soil samples.

Data Interpretation/Data Use

A schoolyard or park will be declared acceptable if the three-step test for arsenic is declared acceptable [(1): 95% UCL is less than the RBC; (2): C_{max} is less than the MTCV for subchronic exposure; and (3): C_{max} is less than the MTCV for acute exposure] AND the arithmetic mean for lead is less than the RBC for lead. If any of the three tests for arsenic are declared potentially unacceptable or the mean concentration for lead exceeds the corresponding RBC, the property will be considered to have potentially unacceptable human health risk. If a property is identified as potentially unacceptable, USEPA may either remediate the property in its entirety, or may perform further sampling to determine with greater confidence a) whether remediation is actually needed, and if so, b) which part or parts of the yard require remediation.

Table 2-1 List of Schools and Parks

Category	Name	Sampling Status	
		Completed	Phase III
School	Garden Place ^a	X	
	Mitchell	X	
	Annunciation		X
	Harrington	X	
	Swansea	X	
	Cole Middle School	X	
	Wyatt-Edison		X
	Pioneer		X
	Northeast Montessori		X
	Family Star Montessori		X
	Johnson Headstart		X
	Montessori-Garfield Headstart		X
	Potential new school (44 th & Steel)		X
	Clayton Foundation		X
Park	Swansea	X	
	Elyria	X	
	Schafer	X	
	Russel Square	X	
	Nairobi	X	
	Saint Charles Place	X	
	Durham	X	

a - Soils at Garden Place School were sampled and replaced by Denver Public Schools in 1989. This property was re-sampled by Asarco under the Globe Plan Consent Decree Program.

Figure 2-1: Distribution of Arsenic Values at Impacted Properties

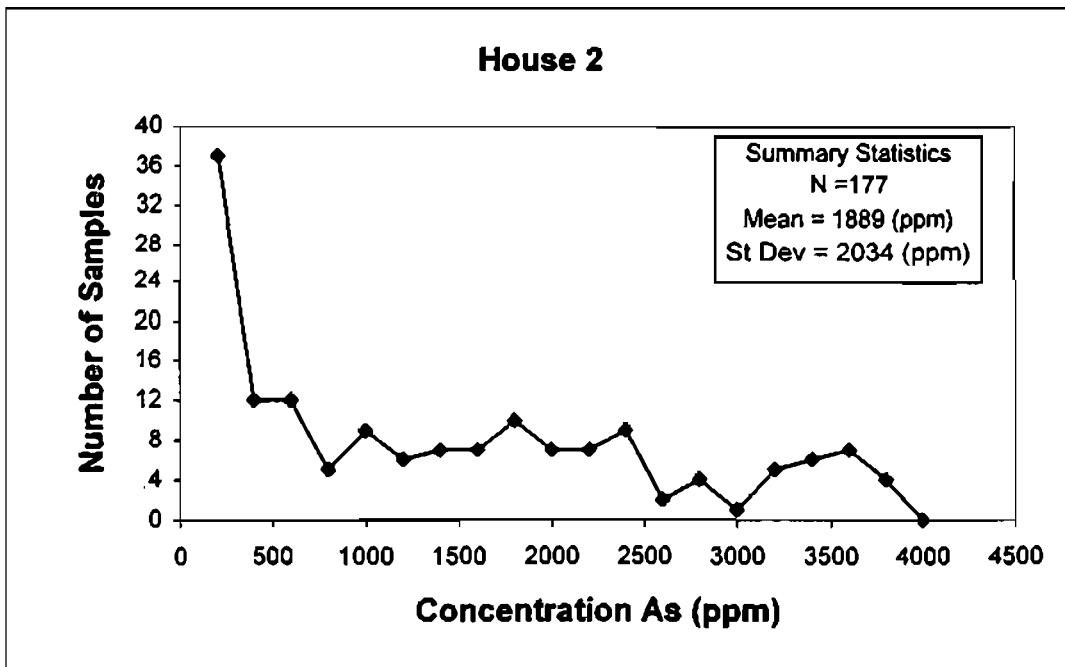
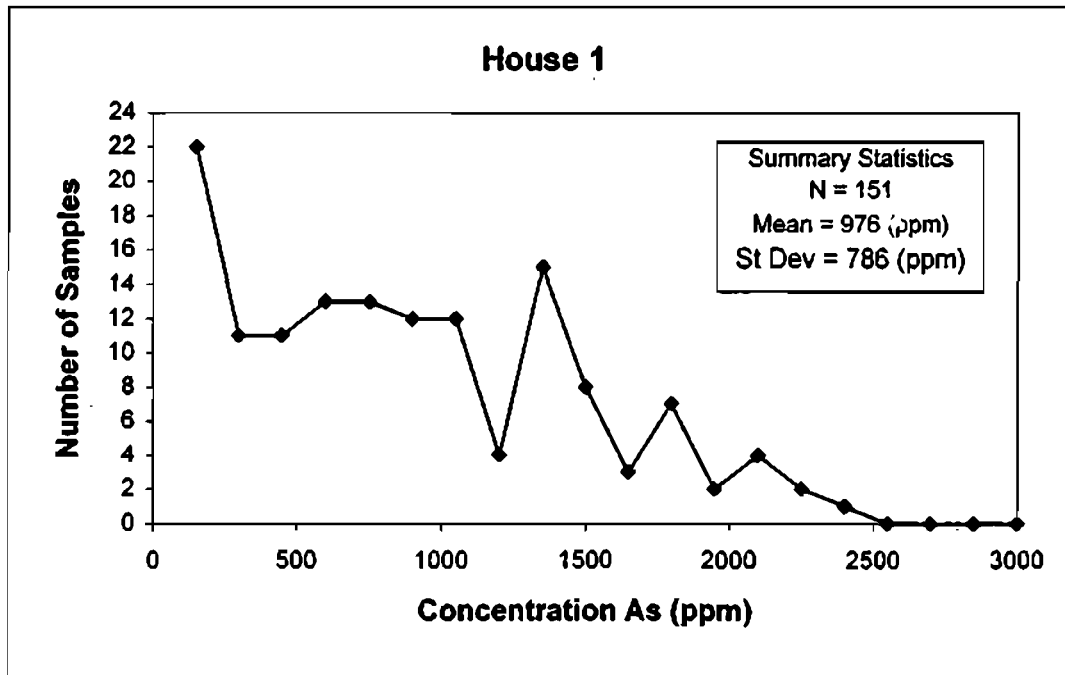


Figure 2-2: Probability Plots of Arsenic Distribution at Impacted Properties

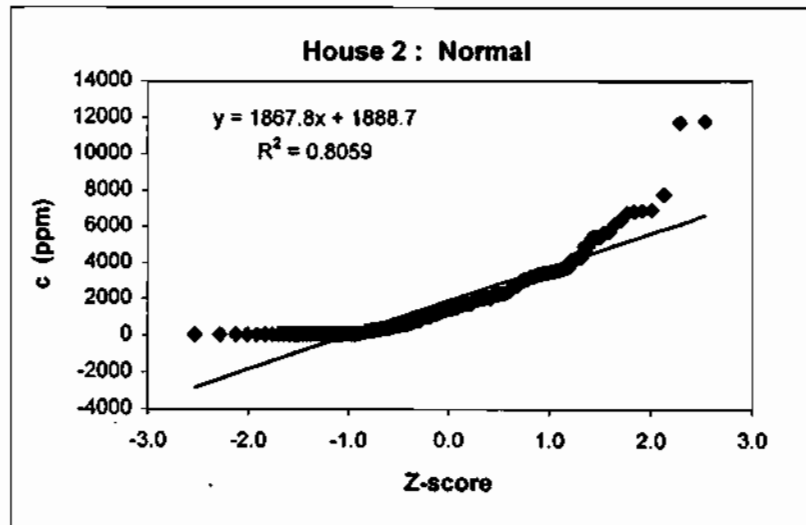
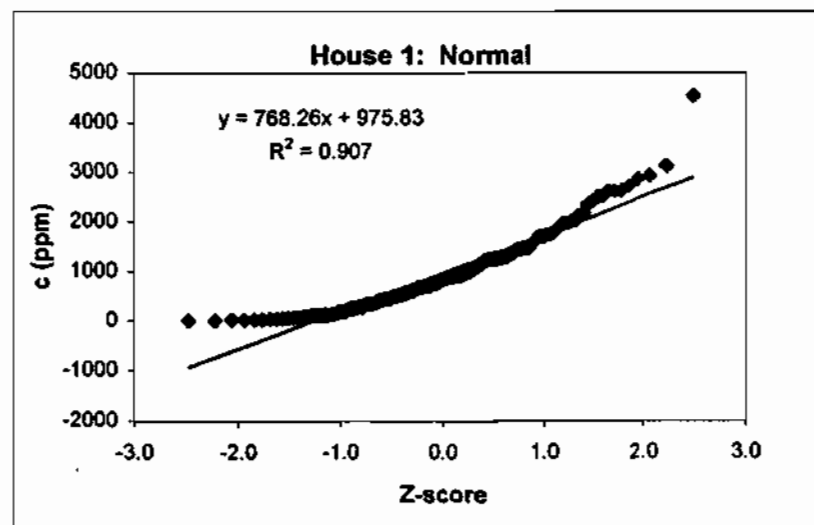
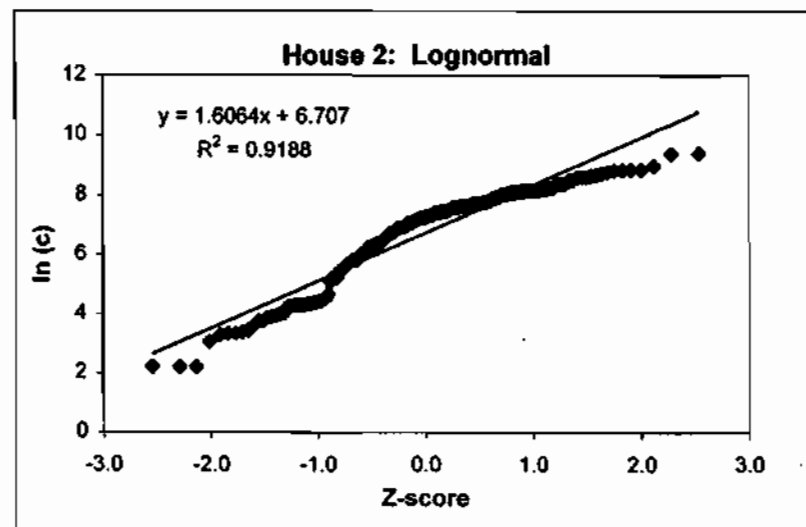
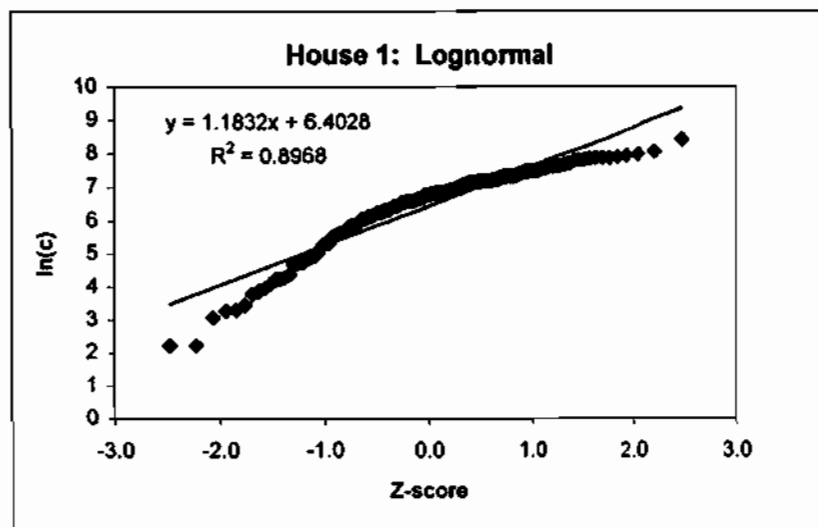


Figure 2-3: Probability Plots of Arsenic Distribution for Minimally Impacted Properties

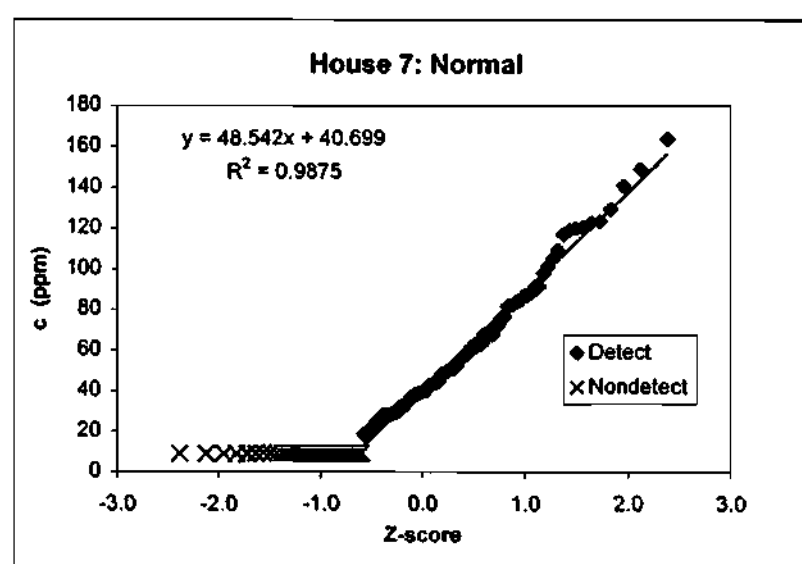
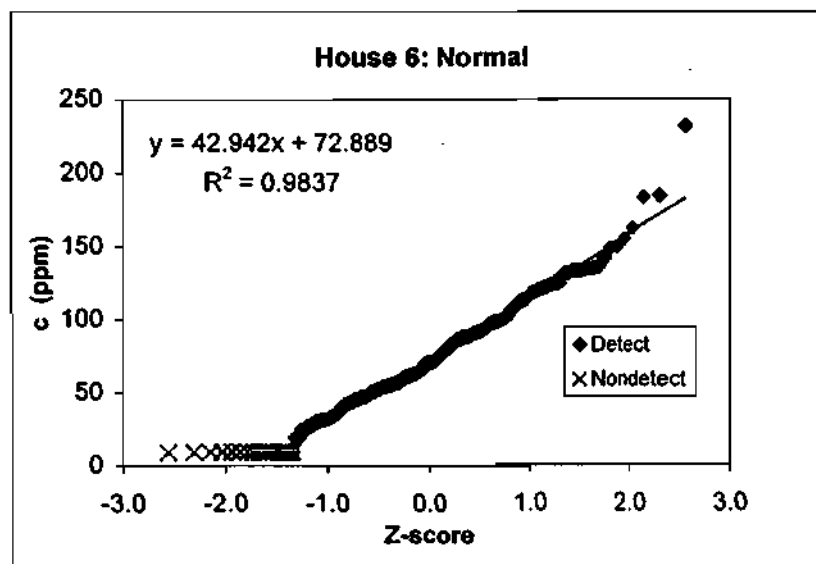
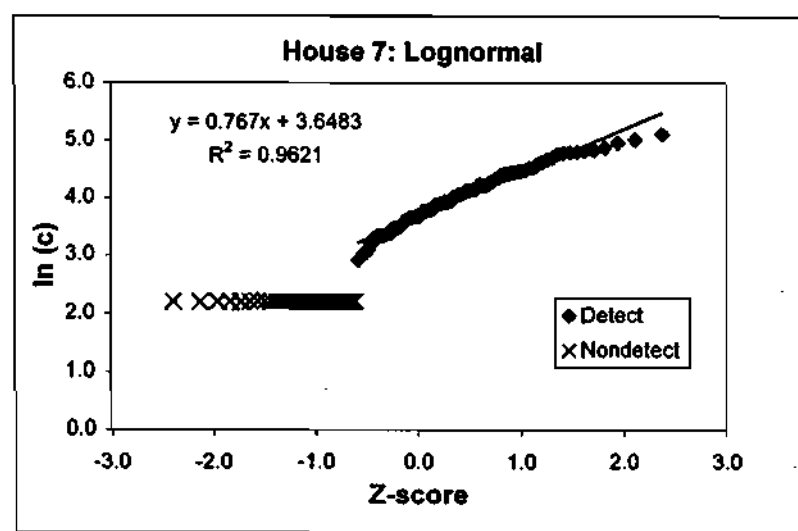
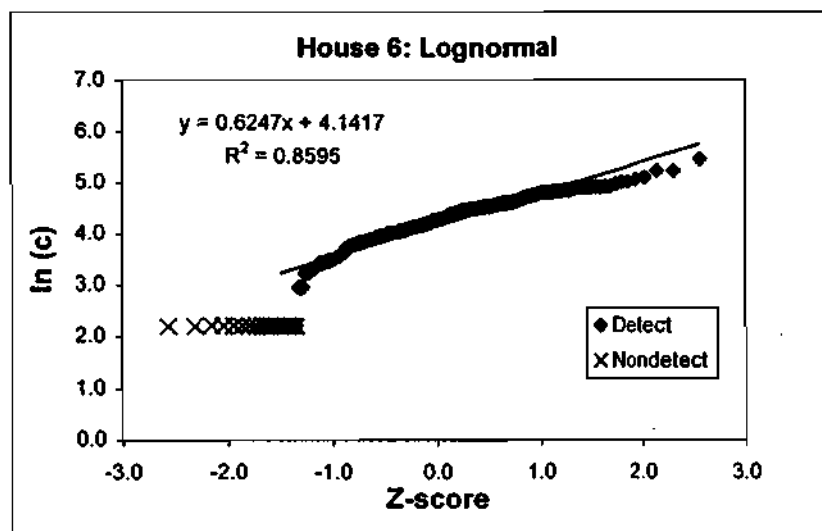
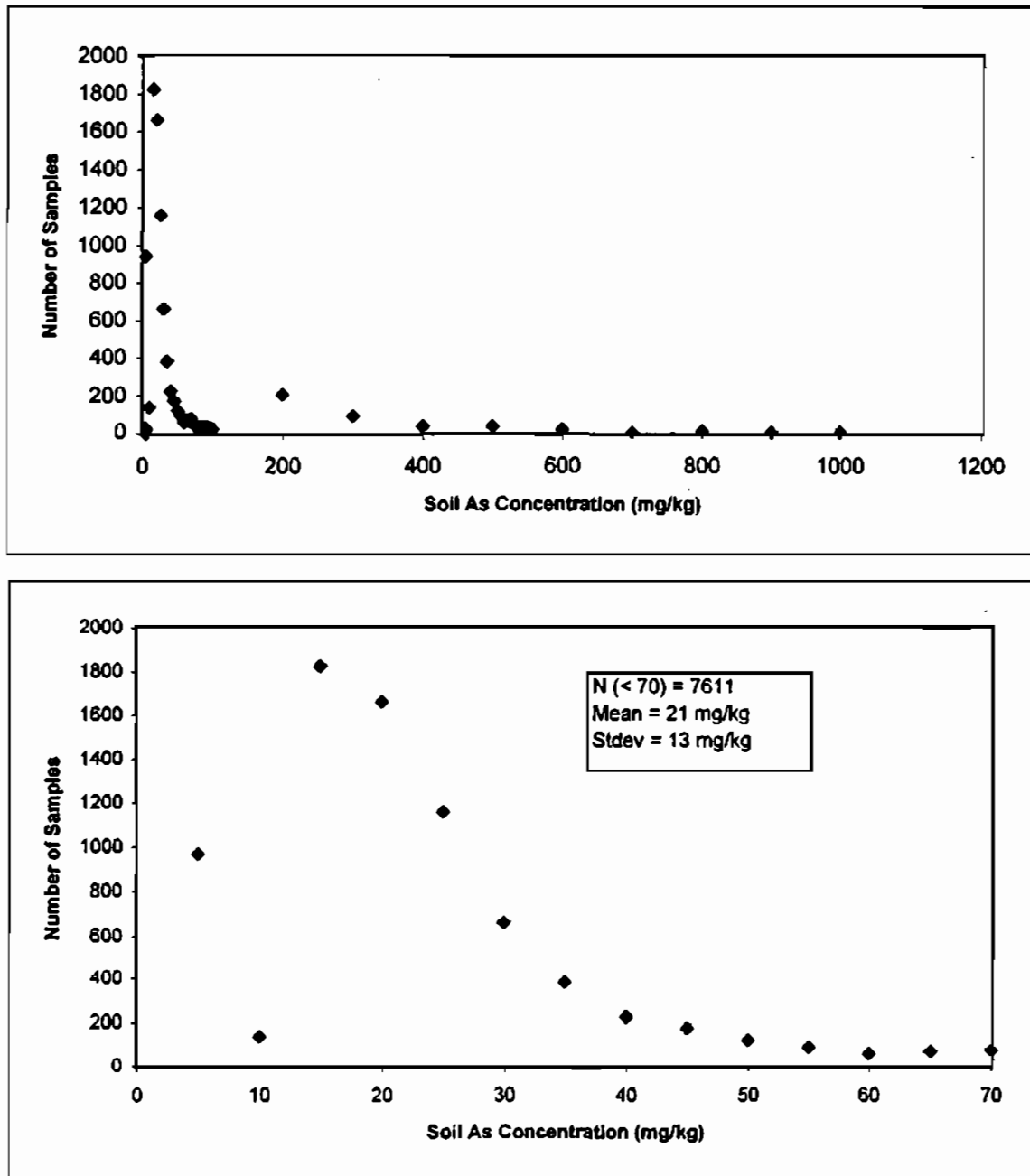


Figure 2-4. Arsenic Levels in Surface Soil at Unimpacted Residences in the Globeville Area



Note: All samples below the detection limit (10 ppm) were assigned a value of 5 mg/kg
Data Source: ASARCO (1999)

3.0 FIELD SAMPLING PLAN

This Field Sampling Plan describes the methods and procedures required for implementation of field sampling activities planned as part of the VBI70 Phase III Field Investigation including: descriptions of the sampling locations; number of samples planned for collection; sample matrices; and methods for sample collection, handling and analysis. Additionally, procedures associated with obtaining property access, waste management and disposal and health and safety are also outlined in this section of the Project Plan.

In general, the steps required for successful implementation of this FSP include:

- Obtain a list of eligible properties for Phase III sampling
- Obtain property access authorization
- Collect samples (e.g., residential yard soil, indoor dust)
- Submit samples under chain-of-custody for analysis
- Perform sample preparation steps
- Perform sample analysis

At each step where data are collected, data must be incorporated into the project database in an accurate and timely fashion in accord with procedures outlined in the Data Management Plan (DMP) in Section 5.0. A sample flow diagram outlining the overall steps for field data collection activities is presented in Figure 3-1.

3.1 Staff Identification

All USEPA personnel and contractors participating in the field sampling or oversight efforts must wear identification at all times. This is important to show residents or observers that field personnel are a part of the Phase III field investigation and belong onsite. Identification (ID) badges should have the name and recent photograph of the person. ID badges must be worn on site and clearly visible at all times.

3.2 Property Access Agreements

As noted previously, approximately 3000 residences are eligible for yard sampling and analysis as part of Phase III. An eligible residential property is any property located within the study boundaries (See Figure 1-2) that has not already had yard soils measured for arsenic and lead as part of Phases I and II (UOS 1998a, 1998b). Written authorization to sample the yard soil must be granted by the property owner prior to sampling. The general process for obtaining and maintaining documentation on property access authorization is summarized in the following subsections. Specific details for obtaining access agreements are provided in the standard operating procedures (SOPs) (Appendix F).

In the event that a residence is selected for supplemental sampling, separate access agreements will be obtained prior to collection of any additional samples. If access inside the residence is necessary (e.g., for collection of indoor dust samples) and the property owner is not the resident, written authorization from the renter/leaser allowing access inside the home must also be obtained and recorded.

3.2.1 Obtaining Access Agreements

Two methods, implemented in a staged fashion, will be employed in an effort to obtain access authorization from as many eligible residential properties as possible. These methods are: a) site-wide mailing; and b) door-to-door interviews.

3.2.1.1 Site-Wide Mailing

List of Addresses

An attempt will be made to contact all property owners and/or residents within the study by U.S. mail to inform each of the plans for the VBI70 Phase III sampling. A current (1998) database containing all tax assessor data for the study area will be purchased. This information will be used to obtain the most current property owner and address data available. After receipt of the database, a copy of the raw database will be stored with data management personnel. The raw database will then be refined as follows:

- Remove any properties that are outside of the study boundaries
- Remove all addresses within the study boundaries for which adequate sampling data are currently available

The revised database (termed the Access Agreement Database) will be forwarded to MK to begin compiling a list of residences to include on the mailing list. After the mailing list is compiled, USEPA will prepare the components of each letter. Because there is a large population of Spanish-speaking residents within the VBI70 site, all documentation prepared for distribution to the public must be available in both Spanish and English versions.

Information to be Distributed

The following information will be distributed to each resident/property owner:

- Cover letter
- Phase III Sampling Fact Sheet
- Access agreement form
- Self-addressed stamped envelope

Examples of the cover letter, the fact sheet, and the access agreement are provided in the SOP (Appendix F). In addition, a letter from community representatives will also be included in the materials distributed to area residents.

Updates/Corrections to Access Agreement Database

In some cases, the database obtained from 1998 tax assessor data may not reflect recent changes in property ownership, and maybe inaccurate or incomplete regarding the type of building (residential, commercial) at specified addresses. Therefore, as field work is undertaken and more accurate information is obtained, updates to the Access Agreement Database will be incorporated.

3.2.1.2 Door-to-Door Recruitment

In cases where no response is received following the site-wide mailing (see above), a team of two people will visit each residence in order to attempt to obtain authorization for soil sampling access. Due to the large number of Spanish-speaking citizens residing in the study area, bilingual personnel will participate in interviews as needed. Each team will have available and will provide to each resident contacted the same set of information and authorization forms that were distributed by mail. The team will describe the goal of the project and clearly state the need for property access. Additionally, the team will explain that authorization onto the property must be given by the property owner. If access is granted, the agreement form will be signed and given to the interviewing team. Authorized members of MK's data entry team will update the Access Agreement Database to indicate whether access was approved or denied as responses are received by the interviewing teams.

3.2.1.3 Follow-up Mailings and Recruitment Activities

Follow-up mailing or door-to-door visits may be implemented at either the soil or indoor dust sampling activities. The RPM will decide whether additional recruitment activities are necessary after receiving the results of the participation rates for each recruitment stage.

3.2.2 Documentation

Recruitment

A cumulative list of all residences that have received mailings and that have been visited will be maintained. This list will document the date when a letter was sent, and the date(s) and time(s) when house visits were performed, along with a record of the outcome (no response, authorization, refusal).

Access Agreements

All signed access agreements will be maintained in a bound logbooks (e.g., three-ring binders). The original signed forms must be placed in a binder and paginated (sequentially numbered) as each new agreement form is received. Data fields that track when access agreement letters are distributed and when access agreement forms are received will be included and updated in the Access Agreement Database in accord with procedures outlined in the DMP (Section 5.0).

3.3 Phase III Field Sampling

After authorization for property access is granted by a sufficient number of property owners to make field implementation effective, the field crew will be assembled. The field crew will be comprised of a Field Project Leader (FPL) who will supervise all field activities, a Field Quality Assurance Coordinator (FQAC) who will ensure that field activities are implemented in accord with project requirements and field samplers (approximately 8 teams of two) who are trained in the sampling methods stipulated for this project. Field sampling activities contained within this project plan for the Phase III investigation have been divided into three major components: residential surface soil, indoor dust sampling and alley sampling. Each of these components are described in the following subsections. Each subsection contains the following information (as applicable). References in parentheses refer to components required by the USEPA guidelines for development of a Quality Assurance Project Plan (QAPP) (USEPA 1998).

- Identification of Sample Locations (B1)
- Measurement of Field Parameters (B1)
- Sampling Method Requirements (B2)
- Sampling Protocols (B2)
- Field Documentation (B3)
- Analytical Method Requirements (B4)
- Sample Preparation (B4)
- Analytical Methods (B4)
- Detection Limit Requirements (B4)

Other key information pertaining to quality assurance/quality control procedures necessary for successful implementation of the investigations are outlined in the QAPP (Section 4.0).

3.4 Residential Yard Soils

Residential yard soils will be collected at each residential property for which access has been granted by the property owner. Because residential yard samples will be collected outside of the home, generally no appointments to schedule sampling events are required. In the event that appointments are necessary, the following general procedure will be implemented.

In general, all scheduled appointments will be tracked using either a bound scheduling logbook or appropriate schedule tracking software.

Missed Appointments

Once an appointment for soil sampling is made, the field team will visit the residence at the appointed time to collect the samples. In the event that no one answers the door, the field team will call the resident using a mobile phone. The team will remain at the residence for at least 15 minutes in case the resident is running late. After 15 minutes has passed without response from the resident, the field team will leave a note on the door reminding about the missed appointment and a phone number to call to reschedule the appointment. Residents will be rescheduled only once. If the resident misses 2 scheduled appointments, this will be interpreted as participant withdrawal.

3.4.1 Residence Identification

The field team will be provided with the street address for each residence to be sampled. The field team will carefully confirm that they have located the specified residence by confirming that the street number and name match. Whenever possible, verbal confirmation of the address will be obtained by speaking to the resident.

3.4.2 Identification and Collection of Yard Soil Samples

All yard soil samples will be collected in accord with the Residential Soil Sampling for Yards and School or Park Soils SOP #ISSI-VBI70-02 (Appendix F). In brief, surface soils (0-2 inches) will be collected at each of 30 sub-locations at each residence, and these 30 sub-samples (grab samples) will be combined in the field into three composite samples. The details for identification and placement of the grab sample locations at each residence is provided in the SOP (Appendix F) and are summarized below. All sampling personnel will be trained in this procedure in order to ensure replicable sample location assignment. There are six major steps in grab sample location identification. They are:

- Measure the property dimensions and draw a field diagram of the property
- Pace off each building or major obstructions and include on the field diagram
- Identify major samplable areas
- Determine the number of sample points in each sub-area
- Record the sample locations
- Mark the sample locations with flags

Measure each yard

The field team leader (TL) will visit a residence at the time of sampling to assign the sampling scheme. The TL will measure the property dimensions with a measuring tape or measuring wheel (± 0.5 feet). A sketch of the property and property dimensions, north orientation, and adjacent streets and alleyways will be prepared on the site diagram.

Pace off each building or obstruction

The TL will then pace off the major permanent structures of the residence (e.g., dimensions of the property boundary, house, garage, driveway, etc.) and prepare a site diagram to approximate scale (± 3 feet on each measurement). The goal is not have a drawing to scale, but instead to have an estimate of the total samplable area in the residential yard. The total samplable area is defined as any area on the property that is free of permanent obstructions. Temporary obstructions such as automobiles or trailers parked on unpaved property locations, picnic tables, plastic or other materials covering the property are not permanent structures and will be considered "samplable". Therefore, areas that could be used in the future if the temporary obstructions were removed, should be identified on the field diagram and must be considered in sample location identification. Figures 3-2 and 3-3 provide examples of a typical residence at the VBI70 site that has been drawn on a grid.

Identify major samplable areas

For each residence, the samplable area will be divided into rectangular subareas, using natural boundaries such as the house, garage, sidewalk or gardens as division markers (See Figure 3-3). A minimum of three and a maximum of eight subareas will be identified to the nearest pace (± 3 ft) Draw the sample areas on the site diagram sheet. The number of squares in each subarea is counted and recorded onto the field data sheet.

Determine the number of sample points in each subarea

Next, the total number of squares contained in all of the subareas will be summed and this number is recorded in the appropriate space on the surface soil data sheet. This number is divided by 30 to determine the relative distance between each sample point and is recorded in the appropriate space on the data sheet (Figure 3-4). To determine the number of sample points in each subarea, the number of squares in each subarea is divided by the relative distance between sample points. Using standard analytical rounding procedures, each number is rounded to the nearest whole number to determine the number of sample points in each subarea. (See Figure 3-3 and 3-4 for example).

Record sample locations

Three composite samples will be collected per residence, each consisting of 10 sub-samples that are identified by marker flags of the same color or number. Although numbers may be used for identification of sample locations, for the purposes of this project plan, all procedural descriptions will be illustrated using colored marker flags (e.g., 10 red, 10 blue, and 10 yellow). Before placing flags into the yard, their planned location will be marked on the site diagram. Marking flag locations on the site diagram before actually placing them will give the TL an opportunity to verify that sample locations are evenly distributed within each subarea, and that 30 sub-sample locations are documented and recorded. In addition, if an error has occurred in the calculation of sub-sample locations, it will be discovered before any flags have been staked. If either permanent or temporary obstructions are present at the intended sampling locations (e.g., sidewalk, shed, garden, etc.), the sample point should be offset so that a surficial yard soil may be collected, then the actual sample location must be correctly documented on the field diagram. If the TL identifies an error in the sample location identification procedures that compromises the readability of the document, a new, revised diagram should be prepared. After recording all of the sample points, the TL should check the site diagram to make sure that sub-sample locations are not clustered in any area (unless clustering is a result of offsetting sample locations due to obstructions), and that they are approximately equidistant throughout the property.

Mark sample locations

Starting at one corner of the property, the field team will stake sub-sample locations using a repeated sequence of three distinct flag types (i.e., Yellow, Blue, Red, Yellow, Blue, Red, etc.) in alternating sequence across subareas. The same flag types must not be placed next to each other, so that an even distribution of flags in each subarea is obtained. As seen in Figure 3-3 the location of each marker flag should be approximately equidistant from the other flags within each subsection. Additionally, each color flag should be alternately placed so that the same color marker flags are not clustered. A sample location or flag color may be reassigned, if clustering is observed.

Surface Soil Collection

The first 10-point composite will be collected by combining the samples at flags of similar color (e.g., red). Grab samples will be collected from the 0-2 inch soil horizon adjacent to each marker flag. Each sample will be collected using a clean coring tool (2-inch diameter). Each grab sample marked by a red flag will be placed into a single zip-lock bag and labeled in accord with the most recent version of the Sample Identification and Tracking SOP (# ISSI-VBI70-01). Because property sizes and obstacles present at each residence may vary significantly, actual sample locations will be identified using a diagram that will be drawn for each individual property sampled. If obstructions are present at the intended sampling locations (e.g., sidewalk,

shed, garden, etc.), the sample point should be offset so that a surficial yard soil may be collected, then the actual sample location must be correctly documented on the field diagram. The second and third 10-point composite samples will be collected in identical fashion but by sampling next to the blue and yellow flags, respectively.

Because of the relatively large number of samples that will be collected at each residential property (thirty 2-inch diameter samples per property), the resulting sample holes or depressions will be backfilled with an USEPA-approved topsoil mixture. Any sod removed temporarily to obtain the soil below will be replaced after backfilling the hole or depression.

If disposable sampling equipment is not used during the sampling event, decontamination procedures must be performed before that equipment may be reused. Decontamination must be performed between collection of composite samples in accord with procedures outlined in the Decontamination SOP #MK-VBI70-07 (Appendix F).

Each field team will carry a three-ring binder that holds the VBI70 Soil Sample Data Sheets (Figure 3-4). These binders will only contain the paperwork necessary to complete a single day of sampling. One data sheet will be completed for each residence, since the data recorded at each property are applicable to each of the three composites collected at that property. Any deviations from standard protocols or notable events (e.g., rainy weather, etc.) should be entered in the section for "Notes". The field team leader will sign the form when sampling is complete and all data are entered onto the form. The field team will not proceed to the next residence until samples are stored in a cooler and paperwork is complete.

At the end of each day of sampling the field teams will return to the Site Office to check-in samples, paperwork and unused sample labels. Samples will be locked and stored under chain-of-custody until they are forwarded for sample preparation and analysis.

3.4.3 Field Documentation

Each sampling team will maintain two forms of field documentation. As discussed above, each team will have a binder containing all field data sheets. Additionally, each team will carry a bound field logbook (not a three-ring binder). Information contained in this log includes the following:

- Sample date
- Sample team ID
- Names of sample team members in attendance
- Weather conditions
- Time sampling begun each day
- Time sampling concluded each day

- Any information that is not limited to a single residence (e.g., deviations to sampling protocols)
- Signature of data logger.

This logbook will be maintained daily during sampling activities. Refer to the Field Documentation SOP # MK-VBI70-05 (Appendix F) for more details.

3.4.4 Sample Preparation

After composite soil samples have been collected, they will be submitted under chain-of-custody for sample preparation. Sample preparation will be performed in accord with the Sample Preparation SOP #MK-VBI70-05 (Appendix F). In brief, the samples will be well-mixed and then oven-dried. Following the drying step, samples will then be sieved and homogenized again. Figure 3-5 provides a flow diagram that summarizes the steps in sample preparation.

Preparation of Bulk Samples

In brief, all composite samples from the field (referred to as “raw” field samples) will be oven-dried and sieved to remove material larger than 2 mm using a #10 stainless steel sieve. The entire mass of each entire raw sample will be sieved in this way. Any material not passing through the 2 mm sieve will be disposed of as IDW. After sieving, the sample passing the sieve (now referred to as the “bulk” sample) is placed into a new zip-lock bag that is labeled with the original sample ID number, except that the suffix is “B” (for bulk) rather than “R” (for raw). From this bag, a 10-g sample is removed, ground and placed in an XRF cup, labeled with the sample ID (suffix = B) and forwarded to the XRF analyst for testing. A record of all drying and sieving procedures must be documented in the Field Sample Preparation Logbook (Figure 3-6). Information such as the sample ID, date of sample preparation, sample mass before and after drying, the duration of drying and the sieve size used will be included in the log.

The effectiveness of mixing will be evaluated by removing ten 10-gram sample aliquots and analyzing the resulting ten samples for arsenic and lead, and evaluating the variability of the analytical results. If the results of this evaluation prove unsatisfactory mixing is occurring preparation of additional investigative samples will cease and corrective actions to improve mixing will be performed and verified prior to preparation of any other investigative samples.

Preparation of Fine Samples

Selected bulk samples will be identified for a second sieving step in order to isolate a fraction of fine particles for analysis. This step will be performed to confirm expectation that arsenic and lead levels are not significantly different in the bulk and fine fractions. This step will be performed for about 60-90 residences. These residences will be selected so that soil

concentrations span the range of reported metals concentrations.

The fine sample is prepared by removing a portion of the bulk sample (about 100 g) and sieving through a #60 stainless steel sieve. After sieving, the material that does not pass through the screen is disposed of as IDW, and the material that does pass through the screen is placed into a new zip-lock bag labeled with the original sample ID number and the suffix "F" (for fine). A 10-g portion of the fine material is removed, ground and placed in an XRF cup, labeled with the sample ID (suffix = F) and forwarded to the XRF analyst for testing.

The effectiveness of mixing will be evaluated by removing ten 10-gram sample aliquots and analyzing the resulting ten samples for arsenic and lead, and evaluating the variability of the analytical results. If the results of this evaluation prove unsatisfactory mixing is occurring preparation of additional investigative samples will cease and corrective actions to improve mixing will be performed and verified prior to preparation of any other investigative samples.

Decontamination

If disposable sieves or other equipment are not used during sample preparation, decontamination procedures must be performed before the tools or equipment may be reused. Decontamination must be performed between samples sieved in accord with procedures outlined in the Decontamination SOP #MK-VBI70-07 (Appendix F).

QA/QC Samples

At the appropriate frequency (See Section 4.0) or as directed by the FQAC, QC samples such as splits or blind standards are inserted into the sample stream. These samples will be logged into the Field QC Sample Logbook (Figures 3-7, 3-8, and 3-9) and assigned a sample ID. This document is a bound (not a three-ring binder) logbook maintained by the FQAC. The appropriate sample ID numbers and labels will be checked-out from the FPL.

Sample preparation must be performed by a technician who will not perform XRF analysis because samples submitted for XRF analysis must be blind. That is, the sample stream will include both investigative samples as well as blind QC samples. Every effort must be made to maintain sample anonymity.

3.4.5 Analytical Method Requirements

Arsenic and lead testing will be performed on all residential soil samples using XRF, providing the chosen XRF methodology can achieve the project-required detection limits (See Section 4.0). A method detection limit study for the chosen instrumentation and proficiency tests for all analysts who will work on the VBI70 Phase III project must be provided to USEPA before

analysis of any field samples may proceed (See Appendix G). XRF analysis will be performed in accordance with the XRF Instrument Operation SOP #MK-VBI70-06.

3.5 Indoor Dust Samples

As discussed in Section 2.0, indoor dust samples will be collected during the Phase III to obtain more information about the site-specific soil:dust ratio at the VBI70 site. This section outlines the details for field collection of indoor dust samples.

3.5.1 Identification of Indoor Dust Samples

A minimum of 60 and a maximum of 90 residences will be identified for indoor dust collection. Locations for collection of indoor dust will be stratified to achieve spatial representativeness and to ensure a wide dynamic range in metals concentrations in yard soil. Stratification will be assigned based on results of residential yard soil measurements and the location of each residence. About 10-15 sampling locations will be selected from each of the five neighborhoods that make up the VBI70 site. Locations will be selected to include approximately equal numbers of samples from properties with soil arsenic concentrations in each of the following ranges: low (<100 mg/kg), medium (100-300 mg/kg) and high (>300 mg/kg). Special priority will be given to properties with the highest contamination levels (e.g., >500 mg/kg), since these locations are especially helpful in defining the relationship between soil and dust.

3.5.2 Scheduling Dust Sampling

After residences are identified for indoor dust sampling based on yard soil levels and proximal location, each resident must be recruited. The owners and residents of homes targeted for indoor dust sampling will be contacted to obtain access. Owners and residents may be contacted by mail or in person to obtain written consent for access. Arrangements will be made to collect the indoor dust samples at a time when the resident will not have vacuumed for at least seven days. In general, all scheduled appointments will be tracked using either a bound scheduling logbook or appropriate schedule tracking software. An example logbook page for Indoor Dust Scheduling is provided in Figure 3-10.

Missed Appointments

Once an appointment for indoor dust sampling is made, the field team will visit the residence at the appointed time to collect the sample. In the event that no one answers the door, the field team will call the resident using a mobile phone. The team will remain at the residence for at least 15 minutes in case the resident is running late. After 15 minutes has passed without response from the resident, the field team will leave a note on the door reminding about the missed appointment and a phone number to call to reschedule the appointment. Residents will

be rescheduled only once. If the resident misses 2 scheduled appointments, this will be interpreted as participant withdrawal and another residence will be selected.

3.5.3 Collection of Indoor Dust Samples

The residences selected for dust sampling will be sampled in accord with the Sampling for Indoor Residential Dust SOP #ISSI-VBI70-04 (Appendix F). In brief, one composite dust samples will be collected at each selected residence using a high-volume vacuum collection device. The composite sample will consist of 8-14 sub-samples (each covering about 4 square feet) taken from living areas (termed living spaces) of the home where the residents are most likely exposed including: bedrooms, family and/or television rooms, kitchens, hallways and entryways. A minimum 1-g dust sample is required before sampling may be considered complete. If a 1-g sample is not collected using the protocols outlined in the SOP, additional templates should be collected from appropriate living areas until sufficient mass is collected. The composite samples will be collected into a bottles that will be covered with a cap and labeled in accord with the Sample Identification and Tracking SOP# ISSI-VBI70-01 (Appendix F).

All reusable indoor dust sampling equipment (e.g., nozzle, etc.) must be decontaminated between residences in accord with procedures outlined in the Decontamination SOP #MK-VBI70-07 (Appendix F).

Each field team will carry a three-ring binder that holds the VBI70 Indoor Dust Sample Data Sheets (Figure 3-11). These binders will only contain the paperwork necessary to complete a single day of sampling. One data sheet will be completed for each residence. Any deviations from standard protocols or notable events should be entered in the section for "Notes". The field team leader will sign the form when sampling is complete and all data are entered onto the form. The field team will not proceed to the next residence until samples are stored in a cooler and paperwork is complete.

At the end of each day of sampling the field teams will return to the Site Office to check-in samples, paperwork and unused sample labels. Samples will be locked and stored under chain-of-custody until they are forwarded to the commercial laboratory for sample preparation and analysis.

3.5.4 Field Documentation

Each sampling team will maintain two forms of field documentation. As discussed above, each team will have a binder containing all field data sheets. Additionally, each team will carry a bound field logbook (not a three-ring binder). Information contained in this log includes the following:

- Sample date
- Sample team ID
- Names of sample team members in attendance
- Time sampling begun each day
- Time sampling concluded each day
- Any information that is not limited to a single residence (e.g., deviations to sampling protocols)
- Signature of data logger

This logbook will be maintained daily during sampling activities. Refer to the Field Documentation SOP # MK-VBI70-07 (Appendix F) for more details.

3.5.5 Sample Preparation

After samples have been collected, they are submitted under chain-of-custody to a commercial laboratory sample preparation and analysis. Samples will be sieved to remove foreign objects such as lint or hair using a 150 μm screen. An acid digestion is then performed on the fines fraction of the dust sample. Sample digestions will be performed in accord with USEPA SW-846 Method 3050B or 3051.

3.5.6 Analytical Method Requirements

Arsenic and lead testing will be performed on all indoor dust samples using either ICP, ICP-MS, or GFAA, providing the chosen methodology can achieve the project-required detection limits (See Section 4.0). A method detection limit study for the chosen instrumentation and proficiency tests for all analysts who will work on the VBI70 Phase III project must be provided to USEPA before analysis of any field samples may proceed (See Section 4.0). ICP, ICP-MS or GFAA analysis will be performed in accordance with USEPA SW-846 Methods 6010B, 6020 or 7060/7421, respectively.

3.6 Alley Samples

A subset of unpaved alleyways that exist within the study area will be characterized for arsenic and lead levels in surficial soils as part of the Phase II field investigation. Details of the field activities are summarized in the sections below.

3.6.1 Identification and Collection of Alleyway Soil Samples

Because the Phase III investigation of alley soils is a pilot study, not all alleyways within the Phase III study area will be sampled. Rather, about 4-6 alleyways will be chosen for characterization. Alleys to be sampled will be selected based on results of the residential soil

sampling phase of the field investigation. Preference will be given to alleys that are adjoined by multiple properties that have been sampled, and where at least one of the properties is clearly impacted by arsenic (e.g., mean value is greater than 200 mg/kg). A total of 4-6 alleys will be identified, each consisting of one city block.

Prior to sampling the FQAC or designate will provide maps that identify the chosen alleyways and individual sample locations. The map will be generated using GIS tools and will serve to identify and document sample locations. Grab sample locations will be placed along a center transect of each residential property along the alleyway, three samples will be collected across the alley. Approximately thirty grab samples for the entire block where each transect will be located in the alley at the approximate center of each residential property (see Figure 3-12). The three samples are located at each transect, one in the center and two sides of the alley. The two side locations are about 2 feet from the property line of residences that border the alleyway.

The FPL will identify the actual sampling locations using the map and by placing marker flags at appropriate locations. If obstructions are present at the intended sampling locations, the sample point should be offset so that an alley soil may be collected, then the actual sample location must be correctly documented on the field diagram. All alleyway soil samples will be collected in accord with the Residential Soil Sampling for Alleyway Soils SOP #ISSI-VBI70-03 (Appendix F). In brief, surface soils (0-2 inches) will be collected at all sample locations. Grab samples will be collected from the 0-2 inch soil horizon adjacent to each marker flag. Each sample will be collected using a clean coring tool (2-inch diameter) (Appendix F). The grab samples will be collected into a zip-lock bag and labeled in accord with the Sample Identification and Tracking SOP# ISSI-VBI70-01 (Appendix F).

Because of the relatively large number of samples that will be collected at each alley, the resulting sample holes or depressions will be backfilled with an USEPA-approved topsoil mixture. Any sod removed temporarily to obtain the soil below will be replaced after backfilling the hole or depression.

If disposable sampling equipment is not used during the sampling event, decontamination procedures must be performed before that equipment may be reused. Decontamination must be performed between collection of composite samples in accord with procedures outlined in the Decontamination SOP #MK-VBI70-07 (Appendix F).

Each field team will carry a three-ring binder that holds the VBI70 Alleyway Soil Sample Data Sheets (Figure 3-13). These binders will only contain the paperwork necessary to complete a single day of sampling. One data sheet will be completed for each alley. Any deviations from standard protocols or notable events (e.g., rainy weather, etc.) should be entered in the section for "Notes". The field team leader will sign the form when sampling is complete and all data are entered onto the form. The field team will not proceed to the next alley until samples are stored

in a cooler and paperwork is complete.

At the end of each day of sampling the field teams will return to the Site Office to check-in samples, paperwork and unused sample labels. Samples will be locked and stored under chain-of-custody until they are forwarded for sample preparation and analysis.

3.6.2 Field Documentation

Each sampling team will maintain two forms of field documentation. As discussed above, each team will have a binder containing all field data sheets. Additionally, each team will carry a bound field logbook (not three-ring binder). Information contained in this log includes the following:

- Sample date
- Sample team ID
- Names of sample team members in attendance
- Weather conditions
- Time sampling begun each day
- Time sampling concluded each day
- Any information that is not limited to a single residence (e.g., deviations to sampling protocols)
- Signature of data logger

This logbook will be maintained daily during sampling activities. Refer to the Field Documentation SOP #MK-VBI70-07 (Appendix F) for more details.

3.6.3 Sample Preparation

After grab soil samples have been collected, they will be submitted under chain-of-custody for sample preparation. Sample preparation will be performed in accord with the Sample Preparation SOP #MK-VBI70-05 (Appendix F). In brief, the samples will be well-mixed and then oven-dried. Figure 3-5 provides a flow diagram that summarizes the steps in sample preparation.

Sample preparation must be performed by a technician who will not perform XRF analysis because samples submitted for XRF analysis must be blind. That is, the sample stream will include both investigative samples as well as blind QC samples. Every effort must be made to maintain sample anonymity.

Preparation of Bulk Samples

In brief, all grab samples from the field (referred to as “raw” field samples) will be oven-dried and sieved to remove material larger than 2 mm using a #10 stainless steel sieve. The entire mass of each entire raw sample will be sieved in this way. Any material not passing through the 2 mm sieve will be disposed of as IDW. After sieving, the sample passing the sieve (now referred to as the “bulk” sample) is placed into a new zip-lock bag that is labeled with the original sample ID number, except that the suffix is “B” (for bulk) rather than “R” (for raw). From this bag, a 10-g sample is removed, ground and placed in an XRF cup, labeled with the sample ID (suffix = B) and forwarded to the XRF analyst for testing. A record of all drying and sieving procedures must be documented in the Field Sample Preparation Logbook (Figure 3-6). Information such as the sample ID, date of sample preparation, sample mass before and after drying, the duration of drying and the sieve size used will be included in the log.

Preparation of Fine Samples

Selected bulk samples will be identified for a second sieving step in order to isolate a fraction of fine particles for analysis. This step will be performed to confirm expectation that arsenic and lead levels are not significantly different in the bulk and fine fractions. This step will be performed for about 10% of alley samples collected.

The fine sample is prepared by removing a portion of the bulk sample (about 100 g) and sieving through a #60 stainless steel sieve. After sieving, the material that does not pass through the screen is disposed of as IDW, and the material that does pass through the screen is placed into a new zip-lock bag labeled with the original sample ID number and the suffix “F” (for fine). A 10-g portion of the fine material is removed, ground and placed in an XRF cup, labeled with the sample ID (suffix = F) and forwarded to the XRF analyst for testing.

Decontamination

If disposable sieves or other equipment are not used during sample preparation, decontamination procedures must be performed before the tools or equipment may be reused. Decontamination must be performed between samples sieved in accord with procedures outlined in the Decontamination SOP #MK-VBI70-07 (Appendix F).

QA/QC Samples

At the appropriate frequency (See Section 4.0) or as directed by the FQAC, QC samples such as splits or blind standards are inserted into the sample stream. These samples will be logged into the Field QC Sample Logbook (Figures 3-7, 3-8, and 3-9) and assigned a sample ID. This document is a bound (not a three-ring binder) logbook maintained by the FQAC. The

appropriate sample ID numbers and labels will be checked-out from the FPL.

3.6.4 Analytical Method Requirements

Arsenic and lead testing will be performed on all alley soil samples using XRF, providing the chosen XRF methodology can achieve the project-required detection limits (See Section 4.0). A method detection limit study for the chosen instrumentation and proficiency tests for all analysts who will work on the VBI70 Phase III project must be provided to USEPA before analysis of any field samples may proceed (See Appendix G). XRF analysis will be performed in accordance with the XRF Instrument Operation SOP #MK-VBI70-06.

3.7 Schools and Parks

Table 2-1 lists all schools and parks within the study area and identifies whether or not they have been sampled yet. As mentioned previously, any schools or parks that have been sampled previously are not planned for re-investigation during the Phase III Field Investigation.

3.7.1 Identification and Collection of Soil Samples at Schools and Parks

The specific number and location of samples planned for collection at each school and park included in Phase III field investigations are not summarized here, but will be detailed in an addendum to the Project Plan at a later date. A specific sampling design for each school or park will be prepared to ensure that the sample locations adequately cover each individual property.

All surface soil samples will be collected at schools and parks in accord with the Residential Soil Sampling for Yard Soils SOP #ISSI-VBI70-02 (Appendix F). In brief, surface soils (0-2 inches) will be collected at the frequency specified for each property. The FPL or designate will assign sampling locations as specified by the addendum and will complete the following activities:

- Draw a field diagram of the property and its major components approximately to scale
- Place marker flags at the property in the approximate specified location

Field Diagram

The FPL will pace off the major attributes of the property (e.g., dimensions of the property boundary, playground, etc.) and prepare a field diagram to approximate scale (\pm 3 feet on each measurement). The goal is not have a drawing to scale, but instead to have an estimate of the total samplable area at the property.

Flag Placement in Each Subsection

As discussed previously, sample locations will be identified using marker flags. The locations of each marker flag should be approximately equidistant from the other flags at the property as clustering should be avoided.

Soil Sampling

Samples will be collected from the 0-2 inch soil horizon adjacent each marker flag. Each sample will be collected using a clean coring tool (2-inch diameter) (Appendix F). The particular details for soil sample collection will be provided in the addendum to the project plan.

Because of the relatively large number of samples that will be collected at each property, the resulting sample holes or depressions will be backfilled with an USEPA-approved topsoil mixture. Any sod removed temporarily to obtain the soil below will be replaced after backfilling the hole or depression.

If disposable sampling equipment is not used during the sampling event, decontamination procedures must be performed before that equipment may be reused. Decontamination must be performed between collection of composite samples in accord with procedures outlined in the Decontamination SOP #MK-VBI70-07 (Appendix F).

Each field team will carry a three-ring binder that holds the VBI70 Soil Sample Data Sheets (Figure 3-4). These binders will only contain the paperwork necessary to complete a single day of sampling. One data sheet will be completed for each school or park. Any deviations from standard protocols or notable events (e.g., rainy weather, etc.) should be entered in the section for "Notes". The field team leader will sign the form when sampling is complete and all data are entered onto the form. The field team will not proceed to the next property until samples are stored in a cooler and paperwork is complete.

At the end of each day of sampling the field teams will return to the Site Office to check-in samples, paperwork and unused sample labels. Samples will be locked and stored under chain-of-custody until they are forwarded for sample preparation and analysis.

3.7.2 Field Documentation

Each sampling team will maintain two forms of field documentation. As discussed above, each team will have a binder containing all field data sheets. Additionally, each team will carry a bound field logbook (not a three-ring binder). Information contained in this log includes the following:

- Sample date
- Sample team ID
- Names of sample team members in attendance
- Weather conditions
- Time sampling begun each day
- Time sampling concluded each day
- Any information that is not limited to a single property (e.g., deviations to sampling protocols)
- Signature of data logger

This logbook will be maintained daily during sampling activities. Refer to the Field Documentation SOP # MK-VBI70-05 (Appendix E) for more details.

3.7.3 Sample Preparation

After composite soil samples have been collected, they will be submitted under chain-of-custody for sample preparation. Sample preparation will be performed in accord with the Sample Preparation SOP #MK-VBI70-05 (Appendix F).

Sample preparation must be performed by a technician who will not perform XRF analysis because samples submitted for XRF analysis must be blind. That is, the sample stream will include both investigative samples as well as blind QC samples. Every effort must be made to maintain sample anonymity.

Preparation of Bulk Samples

In brief, all composite samples from the field (referred to as “raw” field samples) will be oven-dried and sieved to remove material larger than 2 mm using a #10 stainless steel sieve. The entire mass of each entire raw sample will be sieved in this way. Any material not passing through the 2 mm sieve will be disposed of as IDW. After sieving, the sample passing the sieve (now referred to as the “bulk” sample) is placed into a new zip-lock bag that is labeled with the original sample ID number, except that the suffix is “B” (for bulk) rather than “R” (for raw). From this bag, a 10-g sample is removed, ground and placed in an XRF cup, labeled with the sample ID (suffix = B) and forwarded to the XRF analyst for testing. Information such as the sample ID, date of sample preparation, sieve size and the duration of drying will be included in the log.

The effectiveness of mixing will be evaluated by removing ten 10-gram sample aliquots and analyzing the resulting ten samples for arsenic and lead, and evaluating the variability of the analytical results. If the results of this evaluation prove unsatisfactory mixing is occurring preparation of additional investigative samples will cease and corrective actions to improve

mixing will be performed and verified prior to preparation of any other investigative samples.

Preparation of Fine Samples

Selected bulk samples will be identified for a second sieving step in order to isolate a fraction of fine particles for analysis. This step will be performed to confirm expectation that arsenic and lead levels are not significantly different in the bulk and fine fractions. This step will be performed for about 10% of samples.

The fine sample is prepared by removing a portion of the bulk sample (about 100 g) and sieving through a #60 stainless steel sieve. After sieving, the material that does not pass through the screen is disposed of as IDW, and the material that does pass through the screen is placed into a new zip-lock bag labeled with the original sample ID number and the suffix "F" (for fine). A 10-g portion of the fine material is removed, ground and placed in an XRF cup, labeled with the sample ID (suffix = F) and forwarded to the XRF analyst for testing.

The effectiveness of mixing will be evaluated by removing ten 10-gram sample aliquots and analyzing the resulting ten samples for arsenic and lead, and evaluating the variability of the analytical results. If the results of this evaluation prove unsatisfactory mixing is occurring preparation of additional investigative samples will cease and corrective actions to improve mixing will be performed and verified prior to preparation of any other investigative samples.

Decontamination

If disposable sieves or other equipment are not used during sample preparation, decontamination procedures must be performed before the tools or equipment may be reused. Decontamination must be performed between samples sieved in accord with procedures outlined in Decontamination SOP #MK-VBI70-07 (Appendix F).

QA/QC Samples

At the appropriate frequency (See Section 4.0) or as directed by the FQAC, QC samples such as splits or blind standards are inserted into the sample stream. These samples will be logged into the Field QC Sample Logbook (Figure 3-7, 3-8, and 3-9) and assigned a sample ID. This document is a bound (not a three-ring binder) logbook maintained by the FQAC. The appropriate sample ID numbers and labels will be checked-out from the FPL.

3.7.4 Analytical Method Requirements

Arsenic and lead testing will be performed on all soil samples using XRF, providing the chosen XRF methodology can achieve the project-required method detection limits (See Section 4.0). A

method detection limit study for the chosen instrumentation and proficiency tests for all analysts who will work on the VBI70 Phase III project must be provided to USEPA before analysis of any field samples may proceed (See Appendix G). XRF analysis will be performed in accordance with the XRF INSTRUMENT OPERATION SOP #MK-VBI70-06.

3.8 Sample Identification

Every field and QC sample collected during this investigation will be identified with a unique sample identification number (sample ID). The sample ID consists of 3 elements as described below. Complete details about the sample ID are provided in the Sample Identification and Tracking SOP ISSI-VBI70-01 (Appendix F).

PHASE. All labels will begin with the number "3" to indicate that the sample is derived from the Phase III Field Investigation.

NUMBER. Each label will include a unique identification number. This number will be a 5-digit sequential number starting with "00001" and progressively increasing until the final sample has been collected or tag number "99999" has been reached.

SAMPLE PREPARATION. Samples will be categorized based upon the sample preparation performed. Categories include, but are not limited to the following. The sample preparation nomenclature may be expanded as needed in the future providing they are approved by the Project Database Manager or designate.

- R Raw sample. Original sample collected during Phase III that is unprocessed.
- A Archived bulk fraction. This sample is prepared by sieving the raw sample and then archiving for future use. This sample is not subjected to heating.
- B Bulk fraction. This sample has been prepared by sieving the sample to < 2 mm and then heating above environmental temperatures (> 50 °C).
- F Fine fraction. This sample has been dried at environmental temperatures (< 50 °C) and then sieved to < 250 µm.

Thus, "3-00001-R" and "3-12846-F" represent possible sample numbers collected during Phase III. This type of sample ID is not "self-reading" (the sample location or QC type cannot be interpreted by reading the sample ID) and has been designed so that sample anonymity may be

maintained through laboratory analysis.

3.9 Sample Handling and Custody Requirements (B3)

At the end of each day, the field team returns the samples and the data sheets to the FPL who reviews the forms for completeness and accuracy. If problems are noted, these must be resolved and corrected before the team leaves the site. If corrections are made to the field notes or data sheets, the field team member will draw a single line through the mistake and initial and date the correction. When the forms are complete and accurate, the FPL signs and dates the forms. All forms are placed in a three-ring binder (the Master Field Logbook) in numerical order by sample ID. Once placed into the Master Field Logbook, the forms are immediately paginated (sequentially numbered). Data from the data collection forms are entered into the project database in accord with procedures outlined in the DMP (Section 5.0).

Samples must be kept under strict chain-of-custody at all times. Refer to chain-of-custody (COC) procedures outlined in the Chain-of-Custody and Sample Handling SOP #MK-VBI70-02 (Appendix F). An example COC form is provided as Figure 3-14.

COC forms will be prepared for every sample (residential, alley, school or park soils or indoor dust) collected in the field immediately following collection of each sample. This same COC form will ultimately be used to transfer of the archive (3-#####-A) sample to the storage unit. An example of this is provided in Figure 3-15. Additionally, a second set of COC forms will be prepared for samples submitted to the contract laboratory for confirmation analysis of soils, equipment blanks or indoor dust samples. An example COC form is provided as Figure 3-16.

3.10 Decontamination Procedure:

Decontamination is defined as physically removing inorganic contaminants and foreign material (e.g., dust, oil, detergent) or altering their chemical character to nonreactive/inert substances. All sampling devices and equipment (e.g. tubing, nozzles, coring tools) that are planned for use to collect samples at more than one location must be decontaminated prior to reuse. Therefore, decontamination (decon) procedures must be rigorously followed to minimize the potential for cross-contamination of samples.

All decon procedures shall be performed at a designated decontamination area. This area should be chosen such that environmental factors (e.g., cross-winds, drafts, dust) are minimized. Decon procedures will be performed in accord with the Decontamination Procedures SOP #MK-VBI70-07 (Appendix F).

3.11 Sample Archives

All surface soil (bulk and fine fractions) and dust samples collected during the Phase III Field Investigation must be retained in a dry and secure (locked with limited access) storage facility for at least 6 months after the last sample has been collected from the study area. A portion of samples may be identified for further characterization; therefore samples must be stored in an organized manner such that quick retrieval is possible. All investigative samples will be held in storage, under chain-of-custody until the Remedial Project Manager (RPM) indicates that these samples may be disposed according to proper waste disposal methods.

3.12 Health and Safety

The contractor implementing this project plan (MK) will be responsible for providing and instituting an approved Health and Safety Plan (HASP) for this site. The HASP must contain a discussion of safety procedures for topics including but not limited to reduction in slips, trips and falls and personal protective equipment (PPE) that is appropriate for all aspects of the investigation; training and certification is required for each activity; and measures for how to deal with contamination of known and unknown composition, if encountered.

3.13 Waste Generation and Management

Any waste is generated as a result of this investigation must be disposed in accord with Federal, State and local regulations. The contractor generating the waste is responsible for proper management and disposal. See Appendix F for the Investigation Derived Waste (IDW) Management SOP #MK-VBI70-04.

Figure 3-1 Phase III Sample Flow Chart

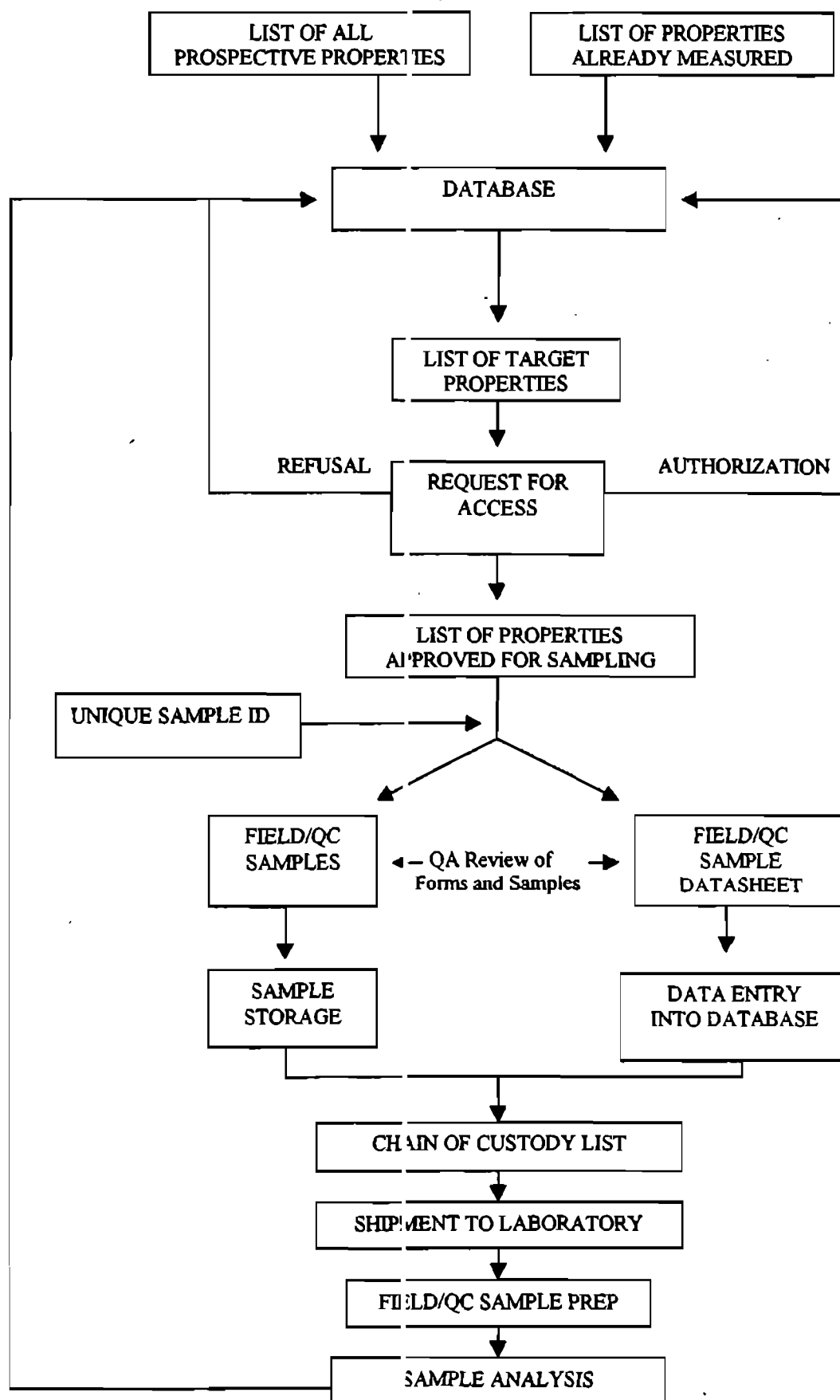
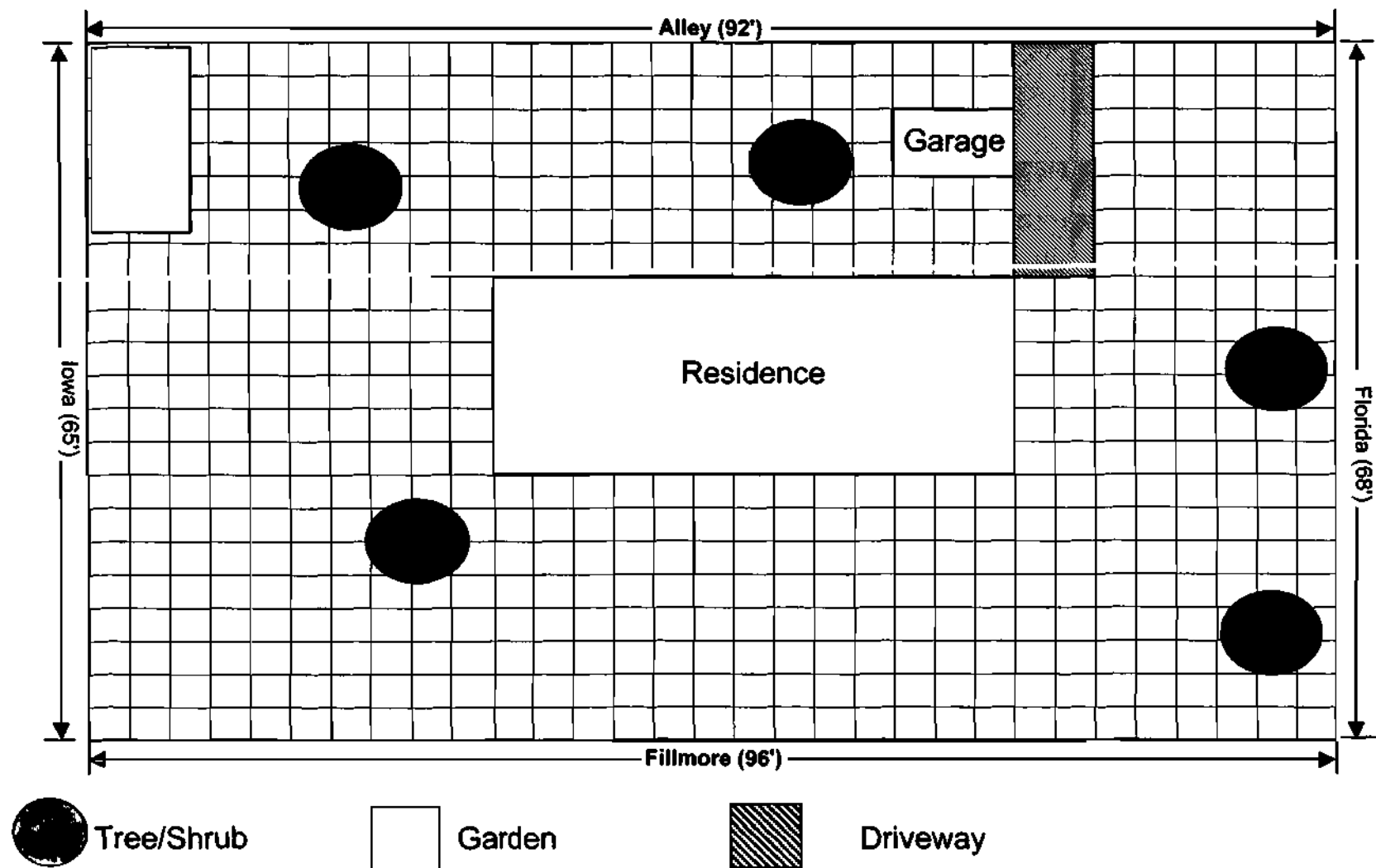


Figure 3-2 Proposed Grid Sampling Design for Residential Surface Soil

Step 1:



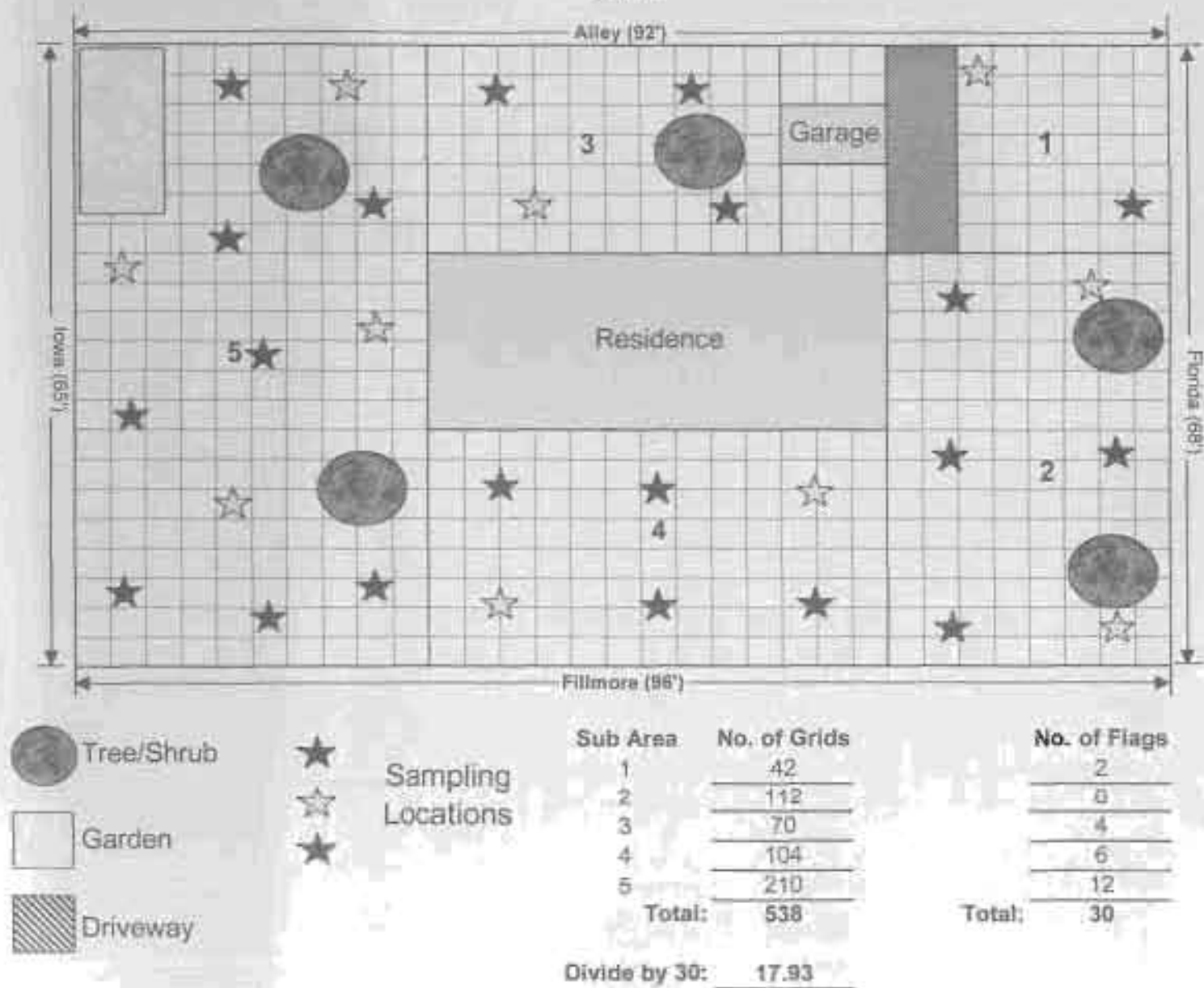
Color Chart(s)

The following pages
contain color that does
not appear in the
scanned images.

To view the actual images, please
contact the Superfund Records
Center at (303) 312-6473.

Figure 3-3 Proposed Grid Sampling Design for Residential Surface Soil

Step 2:



ATTACHMENT 1

SURFACE SOIL DATA SHEET



PHASE: 3
 MEDIUM: SURFACE SOIL
 SAMPLE COLLECTION METHOD: ISSI-VBI70-02 Revision 0
 DEPTH: 0-2"

DATE: _____

SAMPLE TEAM ID: _____

ADDRESS: _____
 House# Street Name

BUILDING TYPE: Residential - Single
 Multifamily
 Apartment

School (Name) - _____

Park (Name) - _____

CLASS: FS (Field Sample)

SAMPLE NO.:

SAMPLE TIME:

SAMPLE TYPE: (circle one)

First
Sample

COMP	GRAB
------	------

Second
Sample

COMP	GRAB
------	------

Third
Sample

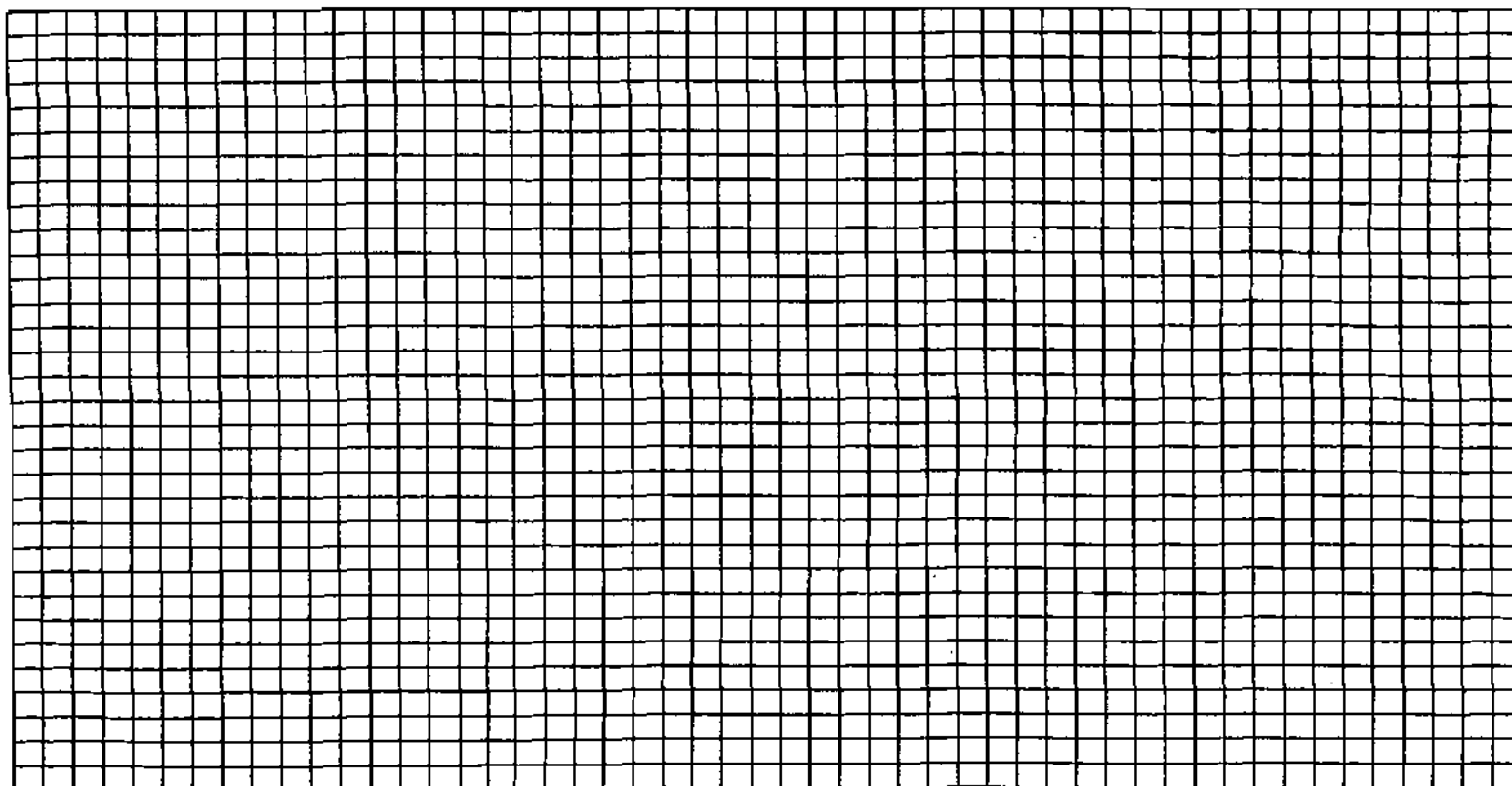
COMP	GRAB
------	------

NOTES:

GARDEN PRESENT?	Yes	No
IN USE?	Yes	No
ADDRESS CONFIRMED BY RESIDENT?	Yes	No
WILLING TO ALLOW FURTHER SAMPLING?	Yes	No

Field Diagram:

N



scale: 1 grid = 1 pece (~ 3 ft)

Sub Area	No. of Grids	Relative Dist. Between Samples (ROBS)	No. of Flags In Sub Area No. of Grids divided by the ROBS	No. of Each Flag (10 of each)
1	_____	Total Grids divided by 30 = _____	_____	Red _____
2	_____		_____	Blue _____
3	_____		_____	Yellow _____
4	_____		_____	
5	_____		_____	
6	_____		_____	
7	_____		_____	
8	_____		_____	
Total Grids: _____			Total Flags: _____	Equal to 30? Y N

Sample Collected by: _____
Signature Date

Logbook Page Reviewed by: _____
Signature Date

Figure 3-5 Soil Preparation Flow Chart

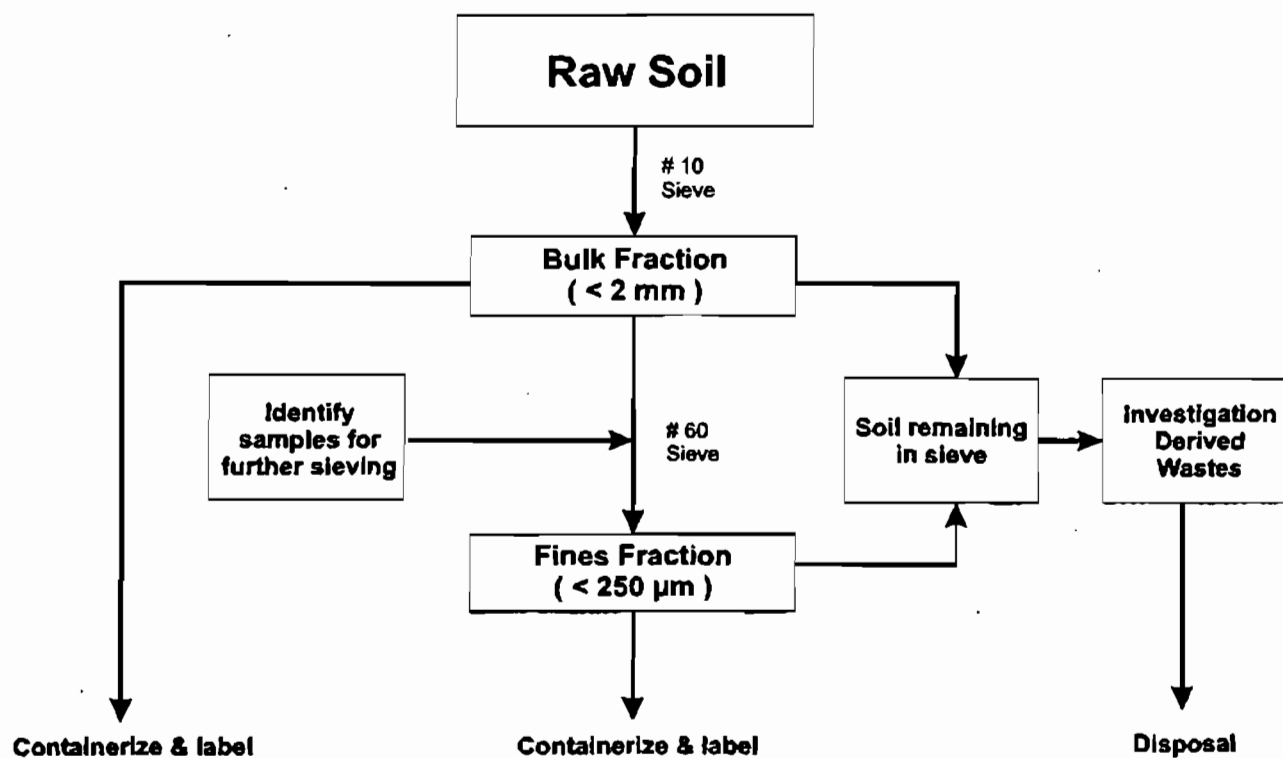


Figure 3-6

VBI70 Field Sample Preparation Logbook Sheet



Sample ID	Prep Batch Number	Confirmation Sample ^a	Sample Drying							Sieving			Notes	
			Date/Time Drying Begun ^b	Date/Time Drying Completed ^b	Oven Temp (°C)	Sample Mass ^c (grams)				Data Sieved	Particle Size Fraction ^d			
						Before	After 1	After 2	After 3		Raw Soil	Bulk (<2 mm)		Fine (<250 µm)

a. Mark an "X" if a confirmation sample is prepared.

b. Enter Date in the following format: mm/dd/yy; Enter Time as 24-hour time (eg. 1340).

c. At least 2 measurements will be recorded. The sample is "completely dry" if the mass measurement is stable. A stability study will be performed as outlined in the Phase III Project Plan.

d. Mark an "X" for each sieve fraction collected

Logbook DCN

[illegible]

[illegible]

Logbook DCN_

[illegible]

a A= Auger, T=Trowel, P=Drying Pan, S=Spatula

Figure 3-10

Logbook DCN _____

VBI70 Indoor Dust Scheduling Sheet



DATE _____

Time	House Number	Street Name	Comments / Special Instructions	Property Access Authorization [1]	
				Property Owner	Renter/Leaser
8:00 AM					
8:30 AM					
9:00 AM					
9:30 AM					
10:00 AM					
10:30 AM					
11:00 AM					
11:30 AM					
12:00 PM					
12:30 PM					
1:00 PM					
1:30 PM					
2:00 PM					
2:30 PM					
3:00 PM					
3:30 PM					
4:00 PM					
4:30 PM					
5:00 PM					
5:30 PM					
6:00 PM					

Notes:

[1] Refer to the Master Access Agreement Log. Indicate with an "X" if access is granted, "NA" if not applicable, or "NO" if access has not been authorized. Do not schedule for dust sampling if "NO" is indicated.

**FIGURE 3-11
INDOOR DUST
DATA SHEET**

PHASE: 3MEDIUM: INDOOR DUSTCOLLECTION METHOD: ISSI-VBI70-04 Revision 0

DATE: _____

SAMPLE TEAM ID: _____

ADDRESS: _____

*House#**Street Name*

CLASS: FS (Field Sample)

EB (Equipment Blank)

SAMPLE TYPE: COMP
GRABTEMPLATE SIZE: 4 ft²

SAMPLE NO.:

--	--

TEMPLATE COLLECTION LOCATIONS:

Number	Living Area (a)	Surface Type (b)	Notes
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

(a) Living Area Codes:

BR = bedroom

FR = family room / living room

K = kitchen

D = dining / eating area

H = hall way

E = entry way

O = other (note which) _____

(b) Surface Types:

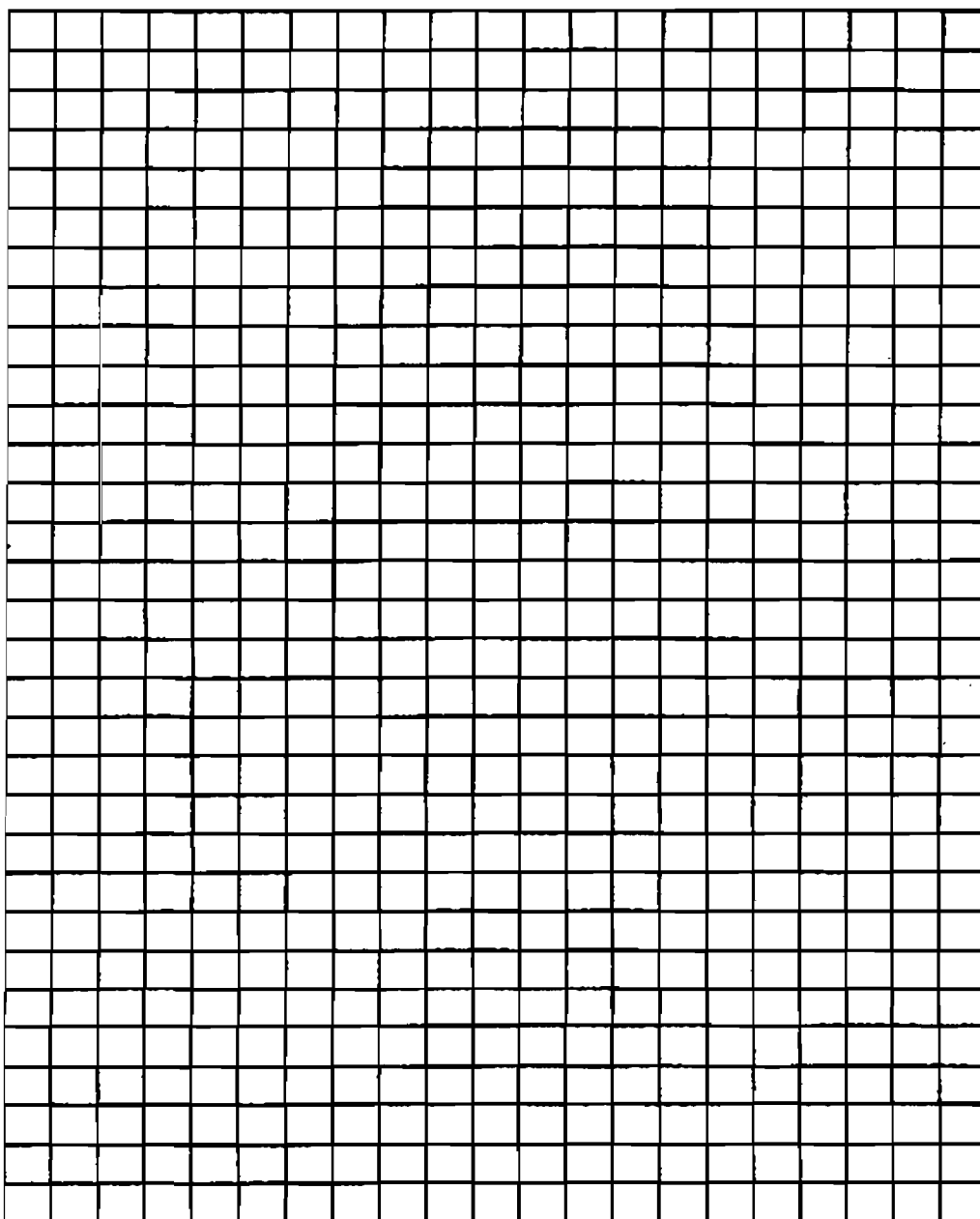
H = hard (linoleum, stone, wood, etc.)

S = soft (carpet, rug, etc.)

O = other (note which) _____

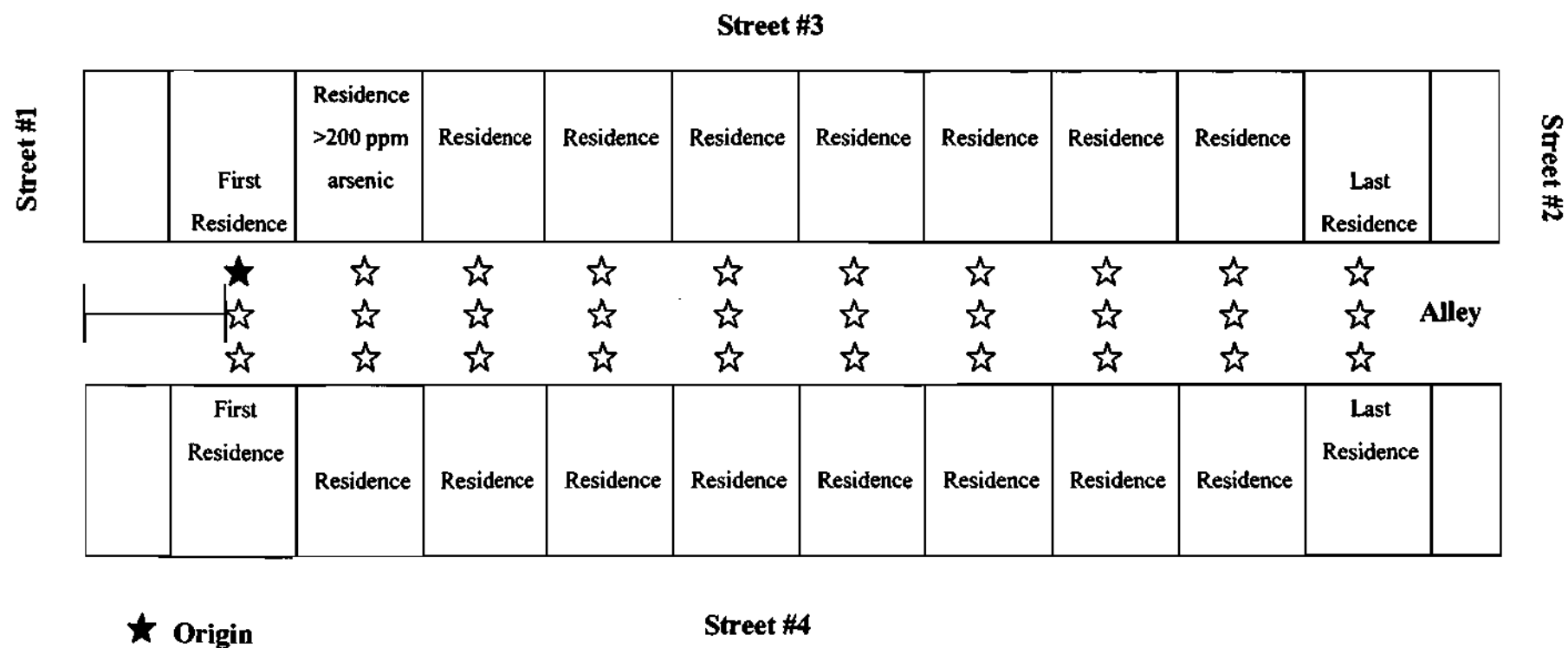
Figure 3-11 (cont.)

Field Diagram:



Samples Collected by: _____
Signature *Date*

Logbook Page Reviewed by: _____
Signature *Date*

Figure 3-12 Typical Sampling Plan at an Alleyway

**FIGURE 3-13
ALLEYWAY SOIL DATA SHEET**

PHASE: 3MEDIUM: Alley Soil

DATE: _____

DEPTH: 0-2"

page 1 of 5

ALLEYWAY ID: _____ SAMPLE COLLECTION METHOD: ISSI-VB170-03 Revision 0

SAMPLE TEAM ID: _____

INDEX	MAP POSITION	SAMPLE NO.	CLASS FS = Field Sample FD = Field Duplicate	SAMPLE TYPE (circle one) COMP GRAB
1			FS FD	COMP GRAB
2			FS FD	COMP GRAB
3			FS FD	COMP GRAB
4			FS FD	COMP GRAB
5			FS FD	COMP GRAB
6			FS FD	COMP GRAB
7			FS FD	COMP GRAB

ALLEY ID: _____

page 2 of 5

INDEX	MAP POSITION	SAMPLE NO.	CLASS FS = Field Sample FD = Field Duplicate	SAMPLE TYPE (circle one) COMP GRAB
8			FS FD	COMP GRAB
9			FS FD	COMP GRAB
10			FS FD	COMP GRAB
11			FS FD	COMP GRAB
12			FS FD	COMP GRAB
13			FS FD	COMP GRAB
14			FS FD	COMP GRAB
15			FS FD	COMP GRAB

ALLEY ID: _____

page 3 of 6

INDEX	MAP POSITION	SAMPLE NO.	CLASS FS = Field Sample FD = Field Duplicate	SAMPLE TYPE (circle one) COMP GRAB
16			FS FD	COMP GRAB
17			FS FD	COMP GRAB
18			FS FD	COMP GRAB
19			FS FD	COMP GRAB
20			FS FD	COMP GRAB
21			FS FD	COMP GRAB
22			FS FD	COMP GRAB
23			FS FD	COMP GRAB

ALLEY ID: _____

page 4 of 6

INDEX	MAP POSITION	SAMPLE NO.	CLASS FS = Field Sample FD = Field Duplicate	SAMPLE TYPE (circle one) COMP GRAB
24			FS FD	COMP GRAB
25			FS FD	COMP GRAB
26			FS FD	COMP GRAB
27			FS FD	COMP GRAB
28			FS FD	COMP GRAB
29			FS FD	COMP GRAB
30			FS FD	COMP GRAB

ALLEY ID: _____

page 5 of 6

INDEX	MAP POSITION	SAMPLE NO.	CLASS FS = Field Sample FD = Field Duplicate	SAMPLE TYPE (circle one) COMP GRAB	ORIGINAL SAMPLE NO.
31			FS FD	COMP GRAB	
32			FS FD	COMP GRAB	
33			FS FD	COMP GRAB	

Samples Collected by:

Signature_____
Date

Logbook Page Reviewed by:

Signature_____
Date



720 Park Blvd., P.O. Box 73
Boise, Idaho 83729
(208) 380-5000

Figure 3-14



CHAIN OF CUSTODY RECORD

720 Park Blvd., P.O. Box 73
Boise, Idaho 83729
(208) 386-5000

[illegible]

Figure 3-15



MORRISON KNUDSEN CORPORATION

CHAIN OF CUSTODY RECORD

720 Park Blvd., P.O. Box 73
Boise, Idaho 83729
(208) 386-5000

Project No.: _____		Project Name: <u>VB170 Phase III</u>			Split Samples		Analysis Required																									
Samplers: (Signature) <u>John Doe</u>		Sampler: (Print) <u>John Doe</u>					<div style="text-align: center;"> </div>																									
Sample Type	Sampling Point Description	Sample Date	Time	Sample I.D. Number	Yes	No														Remarks												
SS	House # & Street Name	8-8-99	1200	3-12345-B	X																											
SS	House # & Street Name	8-8-99	1200	3-12345-F	X																											
SS	House # & Street Name	8-8-99	1200	3-67890-B	X																											
<div style="transform: rotate(-45deg);"> <u>John Doe</u> 8-8-99 </div>																																
Relinquished By: (Signature)		Date/Time	Received By: (Signature)		Relinquished By: (Signature)		Date/Time	Received By: (Signature)		Relinquished By: (Signature)		Date/Time	Received By: (Signature)																			
Company: <u>John Doe/MK</u>		8-8-99 1700	Company: <u>Jenny Nance/Lab</u>		Company:			Company:		Company:			Company:																			
Relinquished By: (Signature)		Date/Time	Received By: (Signature)		Relinquished By: (Signature)		Date/Time	Received By: (Signature)		Relinquished By: (Signature)		Date/Time	Received By: (Signature)																			
Company:			Company:		Company:			Company:		Company:			Company:																			
Relinquished By: (Signature)		Date/Time	Received By: (Signature)		Received for Laboratory By: (Signature)		Date/Time	Received for Laboratory By: (Signature)		Received for Laboratory By: (Signature)		Date/Time	Total No Samples This Shipping Container:																			
Company:			Company:		Company:			Company:		Company:			Company:																			
Relinquished By: (Signature)		Date/Time	Received By: (Signature)		Relinquished By: (Signature)		Date/Time	Received By: (Signature)		Relinquished By: (Signature)		Date/Time	Received By: (Signature)																			
Company:			Company:		Company:			Company:		Company:			Company:																			

Figure 3-16

4.0 QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan has been prepared in accordance with USEPA guidance documents and presents a specific quality assurance and quality control (QA/QC) program required to ensure that the results of the field investigation satisfy project requirements (USEPA 1994a, 1996, 1998a). This section summarizes activities required to ensure that all technical, operational, monitoring and reporting activities are of the highest achievable quality. Sections that are recommended for inclusion (by USEPA guidance) in this portion of the project plan, but that have been presented in previous sections of the document are cross-referenced in this section for clarity and convenience.

4.1 Project Task And Organization (A4)

4.1.1 Project Task (A4)

Project background, study objectives and tasks are summarized in Section 1.0.

4.1.2 Project Organization (A4)

Key USEPA personnel and the contractors who will participate in operations planned for development, implementation, oversight and interpretation of data generated from the Phase III field investigation are presented in Section 1.0.

4.2 Problem Definition and Background (A5)

Project background and problem definitions are presented Sections 1.0 and 2.0, respectively.

4.3 Project Task Description and Schedule (A6)

Project task description including study goals are presented in Sections 1.0 and 2.0. A schedule of planned activities is included in the final project plan.

4.4 Data Quality Objectives (A7)

The DQO process for the overall study objectives for each of the three components presented in this Project Plan is outlined in Section 2.0. DQO requirements that ensure data of sufficient quality are obtained during this investigation are presented in the following section.

4.4.1 Criteria for Measurement Data (A7)

The performance criteria for measurement data generated as part of this project will be evaluated in terms of precision, accuracy, representativeness, completeness and comparability (PARCC). The following sections describe PARCC criteria.

Precision: Precision is defined as the agreement between a set of replicate measurements without assumption or knowledge of the true value. It is a measure of agreement among individual measurements of the same attributes under prescribed similar conditions (e.g., split samples of a residential composite soil). Agreement is expressed as the relative percent difference (RPD) for duplicate measurements if the reported values are sufficiently above the method detection limit (MDL) ($> 5 \times \text{MDL}$) or the absolute difference of two values near the MDL ($\leq 5 \times \text{MDL}$). Where:

$$\text{RPD} = \frac{|2 (A - B)|}{A + B} \times 100\%$$

$$\text{Absolute difference} = |A - B|$$

Where:

A = original concentration value of an analyte

B = duplicate concentration value of an analyte

Accuracy: Accuracy is a measure of the closeness of individual measurements to the "true" value. Accuracy usually is expressed as a percentage of that value. For a variety of analytical procedures, standard reference materials traceable to or available from National Institute of Standards and Technology (NIST) or other sources can be used to determine accuracy of measurements. Specific accuracy guidelines for other accuracy measurements such as calibration verification standards are summarized in Table 4-2. Additionally, criteria are detailed in the individual SOPs or methodologies provided in Appendix F. Accuracy will be measured as the percent recovery (%R) of an analyte.

$$\%R = \frac{A}{B} \times 100\%$$

Where:

A = measured concentration value of an analyte

B = true (known) concentration value of an analyte

Representativeness: Representativeness is defined as the degree to which data accurately and precisely describe the general characteristics of a population or the parameter variations at a

sampling point. It is important to determine whether samples collected for this investigation are representative at both levels and are presented in Section 2.0. At the level of analytical data, representativeness will be measured through evaluation of blanks, accuracy and precision data.

Comparability: Data are comparable if collection techniques and measurement procedures are equivalent for the samples within a sample set. Comparable data will be obtained by specifying standard units for physical and chemical measurements and standard procedures for sample collection, processing, and analysis. Comparability will be documented through analysis of the confirmation samples. See the attached SOPs (Appendix F) for sampling and for analytical procedures.

Completeness: Data are considered complete when a prescribed percentage of the total measurements and samples that are planned are actually obtained.

Collection of Soil data: The overall goal of the study is to obtain soil data from all residential properties in the study area that have not previously been sampled. However, it is expected that not all property owners will grant authorization to sample at their property. Because the participation rate cannot be predicted, a pre-determined completeness goal for this aspect of the project can not be prescribed. All attempts to acquire access (participation) must be carefully documented and data gaps encountered and the potential impact of the gaps will be discussed in the report that details the findings (Section 4.14). However, properties for which authorization to sample is granted, the completeness goal is 100% (i.e., samples will be collected at all properties granting authorization). Within each property that grants authorization, completeness is defined as collection of the specified set of soil samples (3 composites of 10 each) or indoor dust samples.

Analytical Data Produced by Laboratories: Analytical data must be valid for at least 90% of analyzed samples. This means that fewer than 10% of all analytical data generated for each analytical method may incur a qualification of unusable (R qualification). If this completeness goal is not met due to laboratory error (e.g., lab fails to follow prescribed methodology or project-required corrective action), the analytical laboratory responsible for generating the poor quality data must reanalyze samples without additional cost and reanalyses must adhere to method requirements to generate valid data.

4.5 Special Training Requirements and Certification (A8)

Personnel responsible for completing this project include, but are not limited to: toxicologists, chemists, geologists, statisticians, field samplers, data managers and GIS specialists. These technically-trained personnel have been chosen to participate in the investigation because they are experienced in conducting sampling programs, chemical measurements on a variety of

analytical instrumentation and performing interpretation of data generated from the sampling program. Each person working on this project is responsible for attaining and maintaining appropriate training commensurate with their area of expertise.

All sampling personnel as well as all supervisory personnel retained for field sampling activities must be OSHA HAZWOPER (Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Responder) certified. Additionally, site or field supervisors should have the OSHA 8-hour site supervisor training. Field sampling personnel must also be familiar with the information contained in the project plan and must ensure that all project requirements for sampling are met. Likewise, all analysts must be familiar with the project plan and must ensure that all project requirements for sample preparation and analysis are met. Prior to collection and/or analysis of any samples, each team member participating in the field investigations must attend a "readiness review" and must show auditors that he or she is familiar with and has a clear understanding of all procedures and protocols for which that person is responsible.

Each member of the sampling team must sign that he has received a copy, read and understood the Health and Safety Plan (HASP) prior to initiation of field activities. The Health and Safety Officer (HSO) must keep all signatures on file.

4.6 Documentation and Records (A9)

Maintenance of pertinent documentation is critical for evaluating the success of the investigation. This section describes the laboratory requirements for preparing data packages for this project. In addition, procedures for storing and maintaining laboratory data are described in this section. Documentation describing sample handling and custody requirements are discussed in the FSP (Section 3.0) of the Project Plan.

4.6.1 Field Data (A9)

Field documentation procedures are outlined in Section 3.0, the FSP.

4.6.2 Laboratory Data (A9)

Contract Laboratory Program (CLP)-like data packages will be required for all laboratory analytical data. These CLP-like data packages will include a case narrative, copies of all associated raw data, sample results and all associated QC summaries. A summary of the data package requirements is shown on the next page (as appropriate for the individual cited methods).

Section I **Case Narrative**

- A. Case narrative
- B. Copies of nonconformance/corrective action forms
- C. Copies of sample receipt notices
- D. Internal tracking documents, as applicable
- E. Copies of all chain-of-custody forms

Section II **Analytical Results** - All results will be reported on a dry weight basis.

- A. Results for each parameter including dilutions and reanalysis (dry-weight basis)
- B. Units of measure
- C. Method Detection Limit
- D. Practical Quantitation Limit
- E. Date of sample analysis
- F. Date of sample receipt
- G. Date of sampling
- H. Dilution factor

Section III **QA/QC Summaries**

- A. Method blanks, continuing calibration blanks, preparation blanks, instrument blanks
- B. Initial and continuing calibration verifications
- C. ICP/ICP-MS interference check samples
- D. Matrix spikes and post-digestion spikes
- E. Method duplicate samples
- F. Laboratory control samples
- G. Method of standard additions
- H. ICP/ICP-MS serial dilution
- I. Laboratory Duplicates
- J. Instrument detection limits

Section IV **Instrument Raw Data** – Sequential measurement readout records for XRF, ICP, ICP-MS, GFAA, which will include the following information (as applicable):

- A. Environmental samples, including dilutions and reanalyses
- B. Initial calibration (including reporting whether $r^2 \geq 0.995$)
- C. Initial and continuing calibration verifications
- D. Method blanks, continuing calibration blanks and preparation blanks
- E. ICP/ICP-MS interference check samples
- F. Matrix spike and post-digestion spikes
- G. Matrix duplicate samples
- H. Laboratory control samples

- I. Method of standard additions
- J. ICP/ICP-MS serial dilution

Section V Other Raw Data

- A. Sample digestion and preparation logs
- B. Instrument analysis logs for each instrument used
- C. Standard preparation logs, including initial and final concentrations for each standard used

Section VI Electronic Data – All analytical data will be supplied in electronic form as well as hardcopy form. All data will be provided as outlined in the DMP (Section 5.0).

4.6.3 Data Management (A9)

A complete discussion of data management procedures is provided in the DMP (Section 5.0).

4.7 Measurement And Data Acquisition (B)

This section describes the site investigation design and implementation, including method for sample collection, handling and analysis. In addition, field and laboratory QC procedures and instrument testing, inspection, maintenance and calibration requirements are described. The information for Sections B1 through B4 has been outlined in the FSP (Section 3.0).

4.8 Quality Control Requirements (B5)

The principal objectives of any sampling and analysis program are to obtain accurate and representative environmental samples and to provide valid analytical data. The quality of data will be assessed through the use of QC samples analyzed on a regular basis. Laboratory QC samples will be analyzed as per analytical method protocols to evaluate whether laboratory procedures and analyses have been completed properly. For this project, the types of QC samples to be analyzed are defined and their role in the production of QC data are discussed in the following sections. In addition to the particular QC requirements identified in the subsequent sections, all analyses must be performed within holding times and must adhere to all procedures as outlined in the appropriate SOPs (Appendix F).

4.8.1 Field Quality Control Samples (B5)

Field QC samples are samples that have been either collected or prepared in the field that must be blind to the analyst at the field laboratory or fixed-based (contract) laboratory.

Blind Field Split: Blind field split samples are two aliquots of the same sample that has been prepared blind to the analyst only after the original sample has been properly prepared (oven-dried, sieved and homogenized). These samples are submitted blind by the field sample preparation technician to the field or contract laboratory to measure the precision of laboratory preparation and analysis. Blind field splits are required to be collected at a frequency of 5% of all surface soil samples collected (1 field split per 20 investigative samples). The RPD for blind field splits should not exceed 25% or, alternatively, the absolute difference should not exceed 1 x MDL. However, these acceptance limits may be arbitrary; therefore, a graphical comparison of the original and field split samples should also be prepared. This comparison will include a linear regression and will report the calculated correlation coefficient (r). Additionally, control charting will be performed in accord with standard USEPA protocols and will be used to establish site-specific performance criteria for field split samples. Blind field splits will be prepared for surficial soil samples at residential properties, schools and parks and will be analyzed in the field laboratory. A subset of these samples may be submitted to the contract laboratory for analysis as well.

Field Duplicate: Field duplicate samples are co-located samples that are collected at the site by field sampling personnel. These samples are submitted blind to the field preparation technician and the field or contract laboratory to test both the precision of the analysis and the precision of sample collection. Field duplicates are required to be collected at a frequency of 5% of all surface soil samples collected (1 field duplicate per 20 investigation samples collected). The RPD for field duplicates should not exceed 25% or, alternatively, the absolute difference should not exceed 1 x MDL. However, these acceptance limits may be arbitrary; therefore, a graphical comparison of the original and field duplicate samples should also be prepared. This comparison will include a linear regression and will report the calculated correlation coefficient (r). Additionally, control charting will be performed in accord with standard USEPA protocols and will be used to establish site-specific performance criteria for field split samples. Field duplicate samples will be collected for alley surface soil samples only and will be analyzed in the field laboratory. A subset of these samples may be submitted to the contract laboratory for analysis as well.

Equipment Blank: An equipment blank is a collection of the rinsate produced from rinsing equipment that has been decontaminated after use with 100-120 mLs of analyte-free deionized water. Equipment blanks must be performed at a frequency of 5% of all decontaminations performed on each type of equipment. Concentrations of target analytes greater than 1 x MDL for most analytes and 5-10 x MDL for laboratory-induced contaminants may suggest that field sampling-induced contamination may have occurred. This sample will only be collected by field sampling personnel if decontamination is required. If all field sampling and preparation equipment is disposable (one-use only), then equipment blanks are not collected. This sample will be analyzed by a contract laboratory.

Blind Standard: The accuracy of an analytical method is evaluated by analyzing a sample medium fortified with a known concentration of target analytes that has been certified using the preparation and analysis method for that particular sample medium. This sample is submitted to the field or contract laboratory blind at a frequency of about 0.1% (about 30 samples) for each level. About 3 concentrations levels of blind standards should be available. The accuracy requirements will be provided by the certifying laboratory. Recoveries will also be monitored using control charting. Control charting will be performed in accord with standard USEPA protocols and will be used to establish site-specific performance criteria. These samples will be analyzed in both the field laboratory and contract laboratory.

Confirmation Sample: In accord with USEPA guidelines (SW-846 Method 6200), the analytical results measured by the XRF must be confirmed using another methodology (ICP, ICP-MS or GFAA) and performed by an independent contract laboratory. Confirmation analyses will be performed on at least 10% of surface soils collected during the Phase III Investigation. That is, a split will be submitted for confirmation analysis at a frequency of at least 10% of each type of surface soil (residential, alley and schools or parks). However, a greater frequency of confirmation samples will be required at the outset of the project. At initiation of field analyses, confirmation samples will be submitted to a contract laboratory at a frequency of 33% until confidence in accuracy of results between XRF and another contract laboratory method is obtained. That is, 1 split will be submitted for confirmation analysis for every 3 surface soil samples collected. A graphical comparison of the XRF analysis and the corresponding ICP, ICP-MS or GFAA metals analysis should also be prepared. This comparison will include a linear regression and will report the calculated correlation coefficient (r). Control charting will be performed in accord with standard USEPA protocols and will be used to establish site-specific performance criteria.

4.8.2 Laboratory Quality Control Samples (B5)

Laboratory QC samples are samples that are prepared at the laboratory and are analyzed along with field samples to monitor the accuracy and precision of analysis.

Matrix Spike: A matrix spike sample is an investigative sample having a matrix that is representative of all investigative samples to which a known concentration of target analytes is added. This quality control sample measures the extent that the sample matrix affects the accuracy of reported target analytes and must be performed at a frequency of 5% of all investigative samples prepared for ICP, ICP-MS or GFAA analysis (1 matrix spike for every 20 investigative samples) or 1 per preparation batch, whichever is more frequent. Specific accuracy and method requirements are summarized in Table 4-2.

Laboratory Control Sample (LCS): A LCS originates in the laboratory or is provided as a standard reference material (SRM) by a manufacturer (eg. NIST) and contains target analytes of

known concentration. Because LCSs are independent of the calibration standards, they are analyzed to verify the accuracy of the standards used to calibrate the instrument. A LCS must be performed at a frequency of 5% of all investigative samples prepared for analysis (1 LCS for every 20 investigative samples) or 1 per preparation batch, whichever is more frequent. The LCS must fall within manufacturer's certified acceptance limits. Specific accuracy and method requirements are summarized in Table 4-2.

Laboratory Duplicates: Laboratory duplicates are splits that are prepared by the field or contract laboratory. Because the laboratory is aware that the samples are duplicates, these samples serve to test the precision of the laboratory's sample preparation and analysis. A laboratory duplicate must be performed at a frequency of 5% of all investigative samples prepared for analysis (1 laboratory duplicate for every 20 investigative samples) or 1 per preparation batch, whichever is more frequent. The RPD for laboratory duplicates should not exceed 25% or, alternatively, the absolute difference should not exceed 1 x MDL.

Instrument Blanks: An instrument blank is composed of the reagents, solvents or matrix of investigative sample following sample preparation and are used to discern if laboratory-induced contamination is present. These samples must be inserted in the analysis stream at a frequency of 5% of samples at minimum. Concentrations of target analytes greater than 1 x MDL for most analytes and 5-10 x MDL for laboratory-induced contaminants may suggest that laboratory-induced contamination may have occurred. Corrective actions must take place prior to analysis of investigative samples. Specific accuracy and method requirements are summarized in Table 4-2.

4.9 Detection Limits (B5)

MDLs are defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the true value is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. A MDL study must be performed for each method utilized in the study in accord with guidance outlined in the 40 CFR Part 136, Appendix B.

The PQL is defined as 10 times the standard deviation determined from the MDL study (or often described as 3 times the MDL). The project-required detection limits (MDLs and PQLs) required for each analytical methodology planned for this investigation are summarized below.

Table 4-1 Project-Required Detection Limits for Phase III Investigations

Instrument	Method	Method Detection Limits				Practical Quantitation Limits			
		Arsenic		Lead		Arsenic		Lead	
		mg/L	mg/kg	mg/L	mg/kg	mg/L	mg/kg	mg/L	mg/kg
XRF	SOP #MK-VBI70-06	-	10	-	50	-	30	-	150
ICP	USEPA SW-846 6010B	0.001	0.5	0.001	0.5	0.010	5	0.010	5
ICP-MS	USEPA SW-846 6020	0.005	0.01	0.01	0.5	0.5	1.0	1	5
GFAA	USEPA SW-846 7060 (Arsenic) and 7421 (Lead)	0.005	0.01	0.01	0.005	0.5	1.0	1	5

- Not applicable

XRF - X-ray fluorescence

ICP - Inductively Coupled Plasma

ICP-MS - Inductively Coupled Plasma-Mass Spectrometry

GFAA - Graphite Furnace Atomic Absorption

XRF Detection Limits

A MDL study will be performed on the instrument that will be used at the site to measure arsenic and lead levels in soil prior to initiation of the field investigation. Additionally, further MDL studies will be requested over the life of the project. These studies will be requested at least 3 times during the project, but may be requested more frequently. The additional MDL studies will be designed such that all analysts performing XRF analysis are evaluated. That is, a single analyst may not perform every MDL study. Further, the MDL studies will be designed so that analysis times and days of the week are varied. When a member of the USEPA or designate visits the field laboratory and requests a MDL study be performed, the analyst will complete

analysis of the current sample batch and immediately perform the study using the soil samples provided. At the end of the project, an average MDL will be determined for each target analyte using data from all MDL studies performed over the course of the project. These calculated values will be utilized and reported as the site-specific MDLs for the Phase III Investigation. The site-specific MDLs determined using the XRF will be used to determine the site-specific PQLs.

Laboratory MDLs

Results of a current (performed within a year of when analysis is completed) MDL study must be provided by the analytical laboratory that perform all soil confirmation and indoor dust analyses. Therefore, if more than one analytical laboratory is contracted to provide analytical support, MDL studies must be provided by each for the analyses performed. These studies must be provided prior to analysis of any investigative samples.

4.10 Instrument/Equipment Testing, Inspection and Maintenance Requirements (B6)

Field equipment planned for use during this investigation are a fixed-based XRF. This instrument will be inspected daily to ensure it remains in good working condition. Specific details about instrument inspection and maintenance is provided in the XRF SOP. All information relating to the daily instrument inspection, calibration and maintenance will be documented in a field logbook.

Laboratory equipment planned for chemical analysis during this investigation must be inspected daily to ensure it remains in good working condition. Any maintenance that is performed on the instruments must be documented in the respective instrument maintenance logbooks. The logbooks must remain on file accessible at the analytical laboratory for 5 years after analysis of Phase III samples.

4.11 Instrument Calibration and Frequency (B7)

Instrument calibration of field equipment will be performed daily (prior to initiation of analyses) in accord with procedures outlined in the respective SOPs. Calibration of the XRF will include measurement of at least 3 different levels of NIST-certified soil standards that span the range of the expected concentrations. Measurements of calibration standards must be within specifications outlined in the SOP for XRF analysis (Appendix F). Analysis of investigative samples may not begin until measurements of certified standards are within performance limits.

Laboratory instrumentation, used for sample analyses, will be calibrated in accordance with the SOPs or recommended USEPA methodologies. Calibrations must be acceptable before any measurements on investigative samples may be made. Traceable calibration standards will be

obtained by the analytical laboratories. All documentation relating to receipt, preparation and use of standards will be recorded in the appropriate laboratory logbooks. This information will be forwarded as part of the raw analytical data package as described in Section 4.6.2.

4.12 Assessment and Oversight (C)

The following sections describe activities for assessing the effectiveness of the implementation of the project and associated QA/QC. The purpose of the assessment is to ensure that the project plan is implemented as prescribed. The elements include assessments and response actions and reports to management as described in the following sections.

4.12.1 Assessment and Response Actions (C1)

4.12.1.1 Audits (C1)

Assessment of field activities and laboratory analyses will be conducted through oversight of analytical procedures through field and laboratory audits. The purpose of the oversight (audit) activities will be to document field sampling and analysis procedures, to determine if activities are proceeding in accord with project requirements and to document any changes, additions or deletions that have occurred during field sampling and analysis and to identify and immediately implement any corrective actions.

Field audits will evaluate field procedures to ensure that activities are proceeding in accord with the project plan. If conflicts are noted, these must be addressed so that project requirements are met.

Laboratory audits will evaluate laboratory procedures to ensure that they follow Good Laboratory Practices (GLP) Guidelines and to ensure that they do not conflict with project requirements. If conflicts are noted, these must be addressed so that project requirements are met. Additionally, laboratory analyses may also be assessed through submittal of performance evaluation (PE) samples. PE samples may be used as a tool for evaluating the accuracy of laboratory analyses. PE samples are standards submitted blind to the laboratory and are typically submitted prior to submittal of investigative samples. The concentration is unknown to the laboratory analyzing the sample, but known to the submitter. The laboratory reported results for the PE samples will be evaluated by comparison to the certified values provided by the contractor providing field and laboratory oversight (ISSI).

Other audits that will be carried out over the course of the project include:

- Review and verification of procedures followed as part of real-time control charting of QC samples analyzed via field and contract laboratory procedures
- Evaluate the flow of electronic data
- Review and verification of hardcopy data

Audits will review the data flow, verify data entry procedures and evaluate whether data management QC protocols are being observed. If audits resulting from review of any of the procedures reveal that project requirements are not met, then corrective action for the deviation must be requested, reviewed and reported. Results for all audits must be documented and submitted to the USEPA Remedial Project Manager. Information in the report includes:

- Type of System Audit (Field, Laboratory, Data Management, etc.)
- Date of audit
- Summary of procedures reviewed
- Results of the review/audit including any non-conformances noted
- Corrective Action Request(s) [CAR], if non-conformance noted
- Date by which CAR must be received with response

If a CAR is required, a follow-up audit must be performed within 5 working days upon receipt of the CAR to ensure that corrective actions were implemented. A Follow-up audit report describing the new findings must be submitted to the USEPA RPM. More detailed information regarding corrective action procedures is provided in the next section.

4.12.1.2 Corrective Action Procedures (C1)

Two types of corrective actions may result from audits and/or oversight: immediate and long-term. Immediate corrective actions include correcting deficiencies or errors or correcting inadequate procedures. Long-term corrective actions are designed to eliminate the sources of deficiencies or errors. If either type of corrective action is deemed necessary following an audit, each step in the following procedures must be documented:

- Identify the deviation
- Request a corrective action
- Report the problem to the USEPA RPM
- Review the corrective action response
- Perform a follow-up audit to ensure the deviation is not recurring

Appropriate corrective action procedures for specific laboratory or field quality control samples are outlined in the subsequent paragraphs. Refer to Table 4-2 for recommended corrective

4.13 Data Validation And Useability (D)

The following sections describe the requirements and methods for data review, validation and verification. In addition, the process for reconciling the data generated with the requirements of the data user is also defined.

4.13.1 Data Review Validation and Verification (D1)

The process of data review, validation and verification is intended to provide consistent and defensible analytical results. Analytical data generated as part of this project will be reviewed and verified before they are incorporated into the project database. Full data validation will be completed on approximately 10% of the data generated for this project. Abbreviated validation will be completed on all other analytical data. Abbreviated and full data validation criteria are described in Section 4.13.2. Full data validation will be performed in accordance with *USEPA National Functional Guidelines for Inorganic Data Review* (USEPA 1994a), the requirements of this project plan and the requirements in SW-846. Note that the project plan supercedes any discrepancies in accuracy and precision requirements among the three cited documents. Abbreviated validation will utilize these guidelines as they pertain to the components outlined in Section 4.13.2.

4.13.2 Validation and Verification Methods (D1)

Full Validation: Full validation will be conducted on data packages for 10% of the samples submitted for chemical analysis. This will be performed to ensure that data were produced in accord with procedures outlined in this project plan. The following elements will be reviewed for compliance as part of the full data validation:

- Methodology
- Holding Times
- Calibration
- Blanks
- Spikes
- Duplicates
- LCSs
- Practical Quantitation Limits
- Analyte Identification
- Analyte Quantification

Abbreviated Validation/Verification: Abbreviated validation will be completed on 100% of the

analytical results for which full validation was not performed (the remaining 90% of analytical results). This will be performed to ensure that data were produced in accord with procedures outlined in this project plan. The following elements will be reviewed for compliance as part of the abbreviated data validation:

- Methodology
- Holding Times
- Calibration
- Blanks
- Spikes
- Duplicates

4.14 Final Reporting

Data reporting consists of communicating summarized data in a final form. QA for reporting consists of measures intended to avoid or detect human error and to correct identified errors. Such methods include specification of standard reporting formats and contents of measures to reduce data transcription errors.

Laboratory Reports: All raw data and analytical results will be provided by the commercial laboratory. This information will be incorporated into a final report which will be provided in both hardcopy and electronic forms. Copies (hardcopy and electronic) of the raw analytical data packages will be submitted to USEPA for archival. More information regarding data management is provided in Section 5.0.

Study Report: A draft report of all the summary study design characteristics, sample analyses, data quality, correlation results and resulting field and analytical data shall be presented by the prime contractor in both hardcopy and electronic forms. Additionally, the electronic database will also be provided to the USEPA. Simple statistical tests of group treatment differences will be performed and presented as discussed in Section 2.0. This report will undergo technical review by USEPA. If necessary, comments to the draft report will be provided to the prime contractor and a final report will be issued (hardcopy and electronic).

4.15 Reconciliation with Data Quality Objectives (D3)

Information obtained from the VBI70 Phase III Field Investigation will be evaluated through the Data Quality Assessment (DQA) process to determine if the data obtained are of the correct quality and quantity to support their intended use. The DQA process consists of five steps as summarized below (USEPA 1996, 1998b).

Review the DQOs and Sampling Design: DQO outputs will be reviewed to ensure that they are still applicable. The sampling analysis and data collection documentation will also be reviewed for completeness and consistency with DQOs.

Conduct a Preliminary Data Review: Data validation reports will be reviewed to identify any limitations associated with the analytical data. Basic statistics will be utilized where applicable and meaningful graphs of the data will be prepared. This information will be used to learn about the structure of the data and to identify patterns, relationships or potential anomalies/outliers.

Select the Statistical Test: The most appropriate statistical procedure for summarizing and analyzing the data will be selected based on the review of the DQOs, the sampling design and the preliminary data review. Key underlying assumptions will be identified that must hold true for the statistical procedures to be valid.

Verify the Assumptions of the Statistical Test: The statistical test will be evaluated to determine whether the underlying assumption holds or whether departures from the assumptions are acceptable given the actual data or other information about the study.

Draw Conclusions from the Data: Calculations required for the statistical test will be completed and inferences drawn as a result of these calculations will be documented.

Table 4-2: Required Quality Control and Recommended Corrective Action for Phase III Investigations

QC Performed	Sample Matrix	Minimum Frequency	Acceptance Criteria				Recommended Corrective Action					
			General Requirements (GR)*	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06	General Requirements (GR)	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06
Blind Standard	Residential, Alley, School and Park Soils and Indoor Dust	90 samples (30 samples for each spike level) About 3 concentration levels of blind standards will be available.	Accuracy requirements will be provided by the certifying laboratory. Recoveries will also be monitored using control charting. Control charting will be performed in accord with standard USEPA protocols and will be used to establish site-specific performance criteria.	See GR	See GR	See GR	See GR	Verify the percent recovery calculations. If calculations are correct, the EQAC will request the analyst to reanalyze the sample. If reanalysis results are still outside of acceptance limits, submit another blind standard immediately into the sample stream to determine if the analysis shows a trend or an isolated event. Analysis of site samples may be discontinued until the problem is resolved.	See GR	See GR	See GR	See GR
Confirmation Samples	Residential, Alley, School and Park Soils	33% of surface soils until notified by the USEPA RPM, then at least 10% of surface soils	A graphical comparison of the XRF analysis and the corresponding ICP, ICP-MS or GFAA metals analysis should also be prepared. This comparison should include a linear regression with the calculated correlation coefficient (r). R should be >0.9.	N/A	N/A	N/A	N/A	Validate and/or verify the data. Determine if outliers are affecting the correlation. If so, remove the outliers and recalculate r. If no source of error can be identified, report the r value as is.	See GR	See GR	See GR	See GR
Continuing Calibration Blank (CCB)	Residential, Alley, School and Park Soils and Indoor Dust	every 10 samples in the analytical batch (before the CCV), or once every 2 hrs. during the analytical run, whichever is more frequent. A CCB must be run after the last CCV after the last sample	N/A	$\leq 1 \times \text{MDL}$	within $3 \times \text{IDL}$ for each analyte	$< 3 \times \text{IDL}$ for each analyte	N/A	Evaluate instrument or system, locate source of contamination, and perform a system blank to determine if the system blank meets acceptance criteria. Continue to perform system blanks until acceptance criteria are met. Reanalyze the blank and associated investigative samples. If the absolute value of the blank exceeds the PQL, correct the problem, recalibrate instrument, verify the calibration, and reanalyze the preceding 10 analytical samples or all of the analytical samples analyzed since the last good calibration blank.	All samples following the last acceptable CCB must be reanalyzed.	If the average recoveries are not within 3 standard deviations of the background mean, terminate analysis, correct the problem, recalibrate the instrument. Re-analyze the previous 10 investigative samples.	Cause of the problem must be determined, corrected, and all samples analyzed since the last acceptable CCB must be re-analyzed. If a lab consistently has concentration values $> 3 \times \text{IDL}$, the IDL may be indicative of an estimated IDL, and must be re-evaluated.	N/A
Energy calibration check		1) Beginning and end of each working day 2) After batteries are changed 3) After instrument has been shut off. 4) Any other time when operator believes that drift is occurring.	N/A	N/A	N/A	N/A	Manufacturer's recommended count time should be used for the check; pure elements (Fe, Mn, Cu, Pb) are usually used for this check	N/A	N/A	N/A	N/A	Reposition pure element sample and reanalyze. If criteria are still not met, energy calibration must be performed as described in the manufacturer's manual. Do not analyze investigative samples until criteria are met.

QC Performed	Sample Matrix	Minimum Frequency	Acceptance Criteria					Recommended Corrective Action				
			General Requirements (GR)*	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06	General Requirements (GR)	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06
Continuing Calibration Verification (CCV)	Residential, Alley, School and Park Soils and Indoor Dust	every 10 samples in the analytical batch (after the CCB) For XRF analyses, once per batch of investigative samples	N/A	90-110% recovery of known value	90-110% recovery of known value	90-110% recovery of known value	80-120% recovery of known value	Verify the percent recovery calculations. If calculations are correct, evaluate the standard to determine if it is faulty. If it is, prepare a new standard and reanalyze the CCV and all associated investigative samples. If necessary, recalibrate the instrument. Do not continue analysis until the problem is solved. If said > control limits, stop analysis, correct problem, recalibrate instrument, verify calibration, and reanalyze all samples analyzed since the last good CCV.	Discontinue sample analysis, determine cause of the problem, correct the problem, and recalibrate the instrument.	See GR	See GR	reanalyze check sample, if still not acceptable, recalibrate instrument; all samples analyzed since the last acceptable CCV must be reanalyzed.
Equipment Blank	Residential, Alley, School and Park Soils and Indoor Dust	5% of all decontamination performed on each type of equipment	target analytes < 1 x MDL; 10 x MDL for laboratory-induced contaminants	See GR	See GR	See GR	N/A	Suggests that field sampling-induced contamination may have occurred. Evaluate all associated QC samples. If all other QC samples are within prescribed acceptance limits, but the equipment blank is not (e.g., positive identifications of target analytes are observed), contact the L&EPA immediately to determine whether resampling and/or reanalysis is required.	See GR	See GR	See GR	N/A
Field Duplicate (FD)	Alley Soils	5% of all surface soil samples. (1 field duplicate per 20)	RPD < 25% or, the absolute difference should not exceed 1 x MDL. A graphical comparison of the original and field duplicate samples should also be prepared. Recoveries will also be monitored using control charting. Control charting will be performed in accord with standard USEPA protocols and will be used to establish site-specific performance criteria. This comparison will include a linear regression and will report the calculated correlation coefficient. R should be >0.9.	See GR	See GR	See GR	See GR	Verify the RPD calculation. If this is correct, determine if matrix interference or heterogeneous samples are factors in the poor RPD. If matrix effects or heterogeneous samples are not observed, reanalyze the method duplicate and associated investigative samples. If appropriate, re-extract or redigest and reanalyze the method duplicate and associated investigative samples.	See GR	See GR	See GR	See GR
Blind Field Split (BS)	Residential, School and Park Soils	5% of all surface soil samples. (1 field duplicate per 20)	RPD < 25% or, the absolute difference should not exceed 1 x MDL. A graphical comparison of the original and field duplicate samples should also be prepared. Recoveries will also be monitored using control charting. This comparison will include a linear regression and will report the calculated correlation coefficient. R should be >0.9. Additionally, control charting will be performed in accord with standard USEPA protocols and will be used to establish site-specific performance criteria.	See GR	See GR	See GR	See GR	Verify the RPD calculation. If this is correct, determine if matrix interference or heterogeneous samples are factors in the poor RPD. If matrix effects or heterogeneous samples are not observed, reanalyze the method duplicate and associated investigative samples. If appropriate, re-extract or redigest and reanalyze the method duplicate and associated investigative samples.	See GR	See GR	See GR	See GR

QC Performed	Sample Matrix	Minimum Frequency	Acceptance Criteria					Recommended Corrective Action				
			General Requirements (GR) *	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06	General Requirements (GR)	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06
Initial Calibration Blank (ICB)	Residential, Alley, School and Park Soils and Indoor Dust	beginning of each run or beginning of every new shift (whichever is more frequent)(before the ICV)	N/A	≤ 1 x MDL	< 1 x MDL	< 3 x IDE for each analyte.	N/A	Evaluate system, locate source of contamination, and perform a system blank to determine if the system blank meets acceptance criteria. Perform instrument maintenance until analysis of system blanks meets acceptance criteria. <i>Do not begin analysis of investigative samples until criteria are met</i>	Determine the cause, correct the problem, and recalibrate the instrument before any samples are analyzed	See GR	See GR	N/A
Initial Calibration Verification (ICV)	Residential, Alley, School and Park Soils and Indoor Dust	beginning of each run and end, after the last analytical sample, or beginning of every new shift (whichever is more frequent)(after the ICB)	N/A	90-110% recovery of known value	90-110% recovery of known value	90-110% recovery of known value	Follow procedures outlined in operator's manual. 80-120% recovery of known value, regardless of which calibration procedure is used	Verify the percent recovery calculations. If calculations are correct, evaluate the standard to determine if it is faulty. If it is, prepare a new standard and reanalyze the ICV and all associated investigative samples. If necessary, recalibration the instrument. <i>Do not continue analysis until the problem is solved.</i>	Calibration curves must cover the appropriate concentration range, as determined by Project specifications. Blanks and standards should produce an absorbance of 0.0 - 0.7	Terminate analysis, correct the problem, and recalibrate the instrument. Any sample analyzed under an out-of-control calibration must be re-analyzed	Terminate analysis, correct the problem, and recalibrate the instrument. Any sample analyzed under an out-of-control calibration must be re-analyzed.	Follow corrective procedures as outlined in operator's manual.
Laboratory Control Sample (LCS) or Standard Reference Material (SRM)	Residential, Alley, School and Park Soils and Indoor Dust	5% or 1 per batch (whichever is more frequent)	must be within manufacturer's established acceptance limits	80-120% of known value	See GR	See GR	Follow procedures outlined in operator's manual. 80-120% recovery of known value, regardless of which calibration procedure is used.	Verify the percent recovery calculations. Evaluate the standard to determine if it is faulty. If it is, prepare a new standard and reanalyze the LCS and associated investigative samples. If necessary, recalibrate the instrument. <i>Do not continue analysis until the problem is solved</i>	Re-run the LCS or SRM one time. If still not acceptable, all samples analyzed after the last acceptable LCS must be re-prepped and re-analyzed	See GR	See GR	See GR
Matrix Spike (MS)	Residential, Alley, School and Park Soils and Indoor Dust	5% or 1 per batch (whichever is more frequent)	N/A	80-120% recovery of known value	75-125% spiked sample recovery (spiking level plus original sample level)	75-125% recovery of known value	N/A	Verify the matrix spike percent recovery calculations and evaluate the LCS percent recoveries. If the calculations are correct and the LCS recoveries are acceptable, determine if matrix interference is a factor in the poor recoveries. If matrix effects are not observed, reanalyze the matrix spike and associated investigative samples. <i>If appropriate, re-extract or redigest and reanalyze the matrix spike and associated investigative samples</i>	Interference test must be conducted (see SW 846 Method 7060 and 7421 for description of interference tests).	Locate source of the problem, correct it, and re-analyze any samples that were run during the out-of-control condition.	Locate source of the problem, correct it, and re-analyze any samples that were run during the out-of-control condition.	N/A

QC Performed	Sample Matrix	Minimum Frequency	Acceptance Criteria					Recommended Corrective Action				
			General Requirements (GR) *	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06	General Requirements (GR)	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06
Method Blank (MB)	Residential, Alley, School and Park Soils and Indoor Dust	5% or 1 per batch (whichever is more frequent) For XRF: each working day before and after analytical run, 1 per 20 investigative samples during run, when contamination is suspected by the operator. Manufacturer's recommended count times per source should be used	Absolute value < PQL	< 1 x MDL; 10% of lowest concentration for each analyte.	< 1 x MDL except for common laboratory contaminants which may be 5-10 x MDL. If any analyte concentration is > PQL, the lowest conc. of that analyte in the associated samples must be 10x more than the conc. found in the blank.	< 1 x MDL except for common laboratory contaminants which may be 5-10 x MDL. If any analyte concentration is > PQL, the lowest conc. of that analyte in the associated samples must be 10x more than the conc. found in the blank.	< MDL for each analyte.	Evaluate instrument, locate source of contamination, perform system blanks to confirm that the system blank meets performance criteria. Re-analyze method blank and associated samples. If method blank is still above the acceptance criteria, re-extract or redesign the method blank and all associated samples.	See GR	See GR	See GR	check probe window, blank sample should be checked for contamination. If not contamination present, instrument must be zeroed following manufacturer's instructions. Re-analyze all samples since the last acceptable MB
Method Duplicate (MD)	Residential, Alley, School and Park Soils and Indoor Dust	5% or 1 per batch (whichever is more frequent)	RPD < 25% (if 5 x MDL), absolute difference: 1 x MDL	See GR	RPD < 25% (if 5 x MDL), absolute difference: 1 x MDL	RPD < 25% (if 5 x MDL), absolute difference: 1 x MDL	See GR	Verify the RPD calculation. If this is correct, determine if matrix interference or heterogeneous samples is a factor in the poor RPD. If matrix effects or heterogeneous samples are not observed, reanalyze the method duplicate and associated investigative samples. If appropriate, re-extract or redesign and reanalyze the method duplicate and associated investigative samples.	See GR	See GR	See GR	See GR
Post-digestion Spike (PDS)	Residential, Alley, School and Park Soils and Indoor Dust	as required, if matrix spike does not meet acceptance criteria	N/A	85-115% of known value	85-115% recovery of post-spiked sample	75-125% of known value	N/A	Verify the percent recovery calculations. If these are acceptable and the spike addition produces a minimum level of 10 times to a maximum of 100 times the instrument detection limit (IDL), matrix effects should be suspected. No further action is required.	If recovery <40%, dilute sample by factor of 5-10 and rerun. If after dilution recovery still <40%, report problem to USEPA	Sample must be diluted and re-analyzed to compensate for possible matrix effects. Results must agree to within 10% of the original determination	Sample must be diluted and re-analyzed to compensate for possible matrix effects. Results must agree to within 10% of the original determination	N/A
System Blank	Residential, Alley, School and Park Soils and Indoor Dust	as required, if other blank samples are not meeting acceptance criteria	< 1 x MDL	See GR	See GR	See GR	N/A	Evaluate system, locate source of contamination, and perform a system blank to determine if the system blank meets acceptance criteria. Perform instrument maintenance until analysis of system blanks meet acceptance criteria. Do not begin analysis of investigative samples until criteria are met	See GR	See GR	See GR	N/A

QC Performed	Sample Matrix	Minimum Frequency	Acceptance Criteria					Recommended Corrective Action				
			General Requirements (GR) *	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06	General Requirements (GR)	GFAA Method 7060 & 7421	ICP Method 6010 B	ICP/MS Method 6020	XRF SOP #MK-VB170-06
Instrument Blank (IB)	Residential, Arley, School and Park Soils	5% or 1 per batch (whichever is more frequent)	N/A	N/A	N/A	N/A	Follow procedures outlined in operator's manual. 80-120% recovery of known value, regardless of which calibration procedure is used.	Evaluate system, locate source of contamination, and perform a system blank to determine if the system blank meets acceptance criteria. Perform instrument maintenance until analysis of system blanks meet acceptance criteria. Do not begin analysis of investigative samples until criteria are met.	N/A	N/A	N/A	check probe window; blank sample should be checked for contamination. If not contamination present, instrument must be zeroed following manufacturer's instructions. Re-analyze all samples since the last acceptable IB.

*General Requirements should be followed in all cases, except where the requirements of the method are specified. In those cases, follow general requirements as stated and then refer to specific requirements for each method.

MDL - Method Detection Limit

RPD - Relative Percent Difference

PQL - Practical Quantization Limit

IDL - Instrument Detection Limit

SRM - Standard Reference Material

N/A - Not Applicable

5.0 DATA MANAGEMENT PLAN

This Data Management Plan (DMP) describes the data management practices to be implemented during the performance of the VBI70 Site Phase III Sampling Program. This DMP defines data flow paths, identifies and assigns organizational and individual responsibilities, and describes the procedures and protocols by which the data management processes function.

5.1 DMP Objectives

This DMP is designed to ensure that VBI70 Site data are collected in a consistent manner and transferred to a central repository in an orderly and timely manner. This DMP provides the structure required to incorporate and disseminate data collected during the Phase III Field Investigation.

In summary, the objectives of the DMP are to:

- Identify and assign organizational and individual responsibilities;
- Describe the flow of information through the data management process;
- Describe the checks and controls necessary to insure data accuracy and validity;
- Identify and address key data elements and process dependencies; and
- Provide an organized and controlled system for the handling of data that will allow future users to make informed decisions regarding the comparability of historical data sets.

5.2 Organizational Relationships

Key project personnel and organizational relationships are described in Section 1.0.

5.3 Organizational Responsibilities for the Database

The Project Data Manager (ISSI) is ultimately responsible for the overall data management process of the project database. This process includes the development, implementation, and maintenance of procedures and protocols to ensure that the data are properly documented, stored, retrieved, analyzed, and archived.

MK is responsible for maintaining project files of all data generated during the Phase III field investigation until these files are transferred to the final repository (the Project Database) at ISSI and then ultimately to the files at USEPA. MK and subcontracted analytical laboratories are responsible for collecting data according to project requirements; reviewing data for accuracy, completeness, and technical adequacy under approved quality control procedures; completing, reviewing, and signing appropriate data processing forms; and transferring original data and data forms to the USEPA RPM for cataloging and storage. It is the responsibility of the MK Site

Manager to forward copies of all field and laboratory generated data to the RPM in a timely manner. Validated electronic updates of the database must be submitted by MK on a biweekly basis at a minimum.

5.4 Data Management Team Responsibilities

The key personnel and primary responsibilities of the Data Management Team (DMT) are summarized below. Some of the functional responsibilities described can be held by a single person or delegated to other individuals as appropriate. However, it is the responsibility of the person identified to ensure that tasks are completed.

Data Services Manager (ISSI) - Develops and revises standard operating procedures and protocols for the DMT to achieve data management guidelines. These procedures and protocols are subject to the approval of the USEPA Technical Contact for Data Management/GIS.

Project Database Manager (ISSI) – The Project Database Manager is responsible for overseeing the development, implementation, and maintenance of the computerized database used to electronically store and process project data. The Database Manager is also responsible for the identification and acquisition of hardware and software necessary for the efficient, effective storage, retrieval, and manipulation of computer-based data files. The Database Manager works with project management and technical personnel during initial project planning to identify those key data parameters to be included in the computerized project database and estimates the scope of required data programming, entry, database error-checking, and electronic file maintenance services. The Project Database Manager is also responsible for database security.

Field Activities Database Manager (MK) – The Field Activities Database Manager is responsible for overseeing the accurate and complete population and maintenance of the computerized database used to electronically store and process data obtained during field collection activities. The Field Activities Database Manager is responsible for verification of electronic data entry and maintenance of hard copy forms and logbooks. The Field Activities Database Manager is also responsible for electronic database and document security.

Project Records Manager (USEPA) - The Project Records Manager is responsible for coordinating the receipt, cataloging and filing of all hard copy documents and electronic data deliverables. Upon receipt of a document, the Project Records Manager assigns it a Document Control Number (DCN) and enters this number in the Superfund Document Management System (SDMS). Electronic data are routed to the Project Database Manager for electronic data entry and processing. Hard copy data documents are stored in appropriate project files.

Field Activities Records Manager (MK and ISSI) - The Field Activities Records Manager is responsible for coordinating the receipt, cataloging and filing of all hard copy documents and

electronic data deliverables. Upon receipt of a document, the Field Activities Records Manager assigns it a MK Document Control Number (DCN). The Field Activities Records Manager reviews the document for legibility and completeness. Illegible or incomplete documents are returned to their source for correction/amendment and re-submittal. Hard copy data are forwarded to the Data Entry Clerk for manual data entry and independent data entry verification. Additionally, the Field Activities Records Manager is responsible for coordinating analytical laboratory services, communicating data deliverable requirements, receiving and routing completed laboratory data packages to qualified chemical data validation/verification personnel and ultimately submitting the validated/verified data to the Field Activities Database Manager for incorporation into the database.

Systems Programmer/Analyst (ISSI) - Systems Programmers/Analysts are responsible for assisting the Project Database Manager with developing, implementing, and maintaining computerized databases used to store project data.

Data Entry Clerk (ISSI and MK) - Data Entry Clerks are responsible for the manual entry of selected project data into the electronic database under the direct supervision of the USEPA Work Assignment Manager (WAM). Data Entry Clerks also perform independent error-checks on the data files and make corrections as needed.

5.5 Forms of Data

A variety of data forms are anticipated to be collected during the Phase III Field Activities. These include, but are not limited to:

- Field Data Sheets
- Field observations and measurements
- Maps
- Photographs
- Laboratory analysis results and quality control data
- Information on Requesting and Receiving Property Access

Access Agreements - These data include the property street address and house number, the name and signature of the property owner, the signature date, the owner's phone number and any comments provided by the property owner at the time of access authorization.

Field Data Sheets - These data include identification of sampling locations, the spatial layout and design of existing buildings and structures, sample collection and preparation measurements, and sample identification numbers. The procedures by which these forms are completed are summarized in the FSP (Section 3.0).

Field Observations - These data include descriptions of weather conditions encountered during

sampling, names of the sampling crew, deviations from the FSP or SOP, and any anomalies observed while collecting the sample (e.g., visible staining, strong odor, etc.). The procedures by which these observations are made are summarized in the FSP (Section 3.0).

Maps - Maps may be developed in the field during sample collection efforts (field diagrams) or may be prepared after sampling is complete using GIS tools.

Photographs - Photographs may be taken during implementation of field activities when visual records of the activities are required. Additionally, aerial photographs of the site may be used as a GIS tool for development of a base map of the site.

Laboratory Analyses - The results of physical and chemical laboratory analyses of field samples are another form of data that will be incorporated into the database. Typically, these data are acquired from laboratories in hard copy and/or electronic format.

Differing levels of reliability may be placed on data with respect to their accuracy and precision. Within the context of data management, two distinct types of data will be stored in the Project Database: primary and secondary.

5.5.1 Primary Data

Primary data derive principally from two sources: on-site field observations and laboratory analyses of physical samples taken as a part of on-site investigations. Because these data are collected and tested using procedures and protocols outlined in the Project Plan, they are of quantifiable accuracy and precision. Examples of primary data include field data sheets, field observations, field maps (site diagrams) and analytical laboratory data packages.

5.5.2 Secondary Data

Secondary data include all data generated by private and public entities outside of the scope of the Project Plan. These data typically include such documents as:

- Site-specific and regional vicinity maps
- Historical land use and property ownership records
- Regional geologic, and hydrologic survey data collected by outside firms and public agencies
- Site-specific physical and chemical data generated by outside firms and agencies not directly involved in this study
- Published accounts of investigations undertaken at other sites that may assist in the analysis and interpretation of site-specific primary data collected

If not carefully documented, secondary data can be of variable and indeterminate accuracy and precision. Whenever data obtained from secondary sources are of uncertain merit, they must be used with caution in any decision-making process.

5.6 Data Flow

A conceptual diagram of data flow for the Phase III sampling is presented in Figure 3-1 of the FSP (Section 3.0). The following sections describe the sources of information and the processes identified for the collection, transfer and organization of primary and secondary data sources.

5.6.1 Reference Data Sources

Two principle sources of secondary data are utilized in the collection and management of information for the Phase III investigation, the 1998 City and County of Denver Tax Assessment data and the historical VBI70 Phase I and Phase II site investigation data. These data are used for the purpose of generating key derivative reference tables (Access Agreement Database). As stated in the FSP (Section 3.0), the Access Agreement Database are updated as new data are received during implementation of the Phase III investigation.

1998 City and County of Denver Tax Assessor Data - The initial source of data for property and ownership information is the 1998 City and County of Denver Tax Assessor data purchased from Property Data Center, Inc. (PDC). These data consist of approximately 11,000 property and ownership records bounded to the North by East 52nd Avenue, to the South by East 26th Avenue, to the East by Colorado Boulevard, and to the West by Inca Street. Some of the data points included are: property addresses, coordinates, land use classifications, living area square footage, and ownership information.

Historical Phase I and Phase II Sampling Data – Roughly 1500 properties were sampled for metals in 1998 by Superfund Technical Assessment and Response Team (START) and Response Engineering and Analytical Contract (REAC) personnel. This information is used initially to simply exclude previously sampled properties from the Phase III field sampling event.

The reference tables and data points derived from the reference data are summarized below.

Reference Table	Data Points
List of Prospective Properties	Property address Geographic coordinates Land use classifications Total living area
Ownership Information	Owner name Owner address
Access Agreements	Date of mailing Authorization status Contact information and language preference

The list of all prospective properties is processed, using study area boundary and historical sampling information, to form a list of target properties. Letters requesting from USEPA requesting authorization for access are then generated for owners of target properties and tracked as described in Section 3.0.

5.6.2 Data Acquisition

This section summarizes the collection, transfer and organization of primary field observations and laboratory analyses with regard to the data management process. Details regarding specific data collection procedures can be found in the FSP (Section 3.0).

5.6.2.1 Field Sampling

Prior to field sampling, a list of properties approved for sampling is generated by the Site Manager. Each sampling team is then given blank copies of media specific data collection forms and a set of pre-printed sample identification numbers printed on self-adhesive labels. The data form is filled out at the time of sample collection by the sample collection team according to procedures detailed in the FSP (Section 3.0).

Upon completion of daily sampling activities, the sampling team returns to the field office location with samples and corresponding data sheets. The FPL maintains a log of sample identification numbers that have been used, noting any missing or destroyed labels. Data sheets are forwarded to the FPL for review. Verified forms are then forwarded for entry into the Field

Activities Database for data entry. Refer to the Data Entry SOP No. ISSI-VBI70-05 for more details.

5.6.2.2 Laboratory Data Entry

During sample analysis at the laboratory, analytical results are either entered into the laboratory information management system or directly downloaded from the analytical instrument. The data are reviewed in the laboratory for errors or omissions to assure that the data are reported in the correct format. Upon completion of these efforts, the laboratory submits the data electronically accompanied by the hardcopy raw data to the appropriate Field Activities Records Manager (e.g., ISSI or MK). All data transfer activities follow only after appropriate data screening, verification and validation procedures.

5.7 Database Organization

A database consists of conceptual and physical design components. The conceptual design integrates the intended function, contents, and products of the project database; the procedures for data entry and electronic data incorporation; the needs of data users; and compatibility requirements (within database software limitations). The physical design implements the conceptual design through programming, data incorporation, and built-in software functions.

In addition to meeting the needs of data users, the database management system will incorporate the following capabilities:

- Store tabular data (such as analytical results, qualifier codes, sample locations) in a relational database management system.
- Allow the user to query multidisciplinary data.
- Provide an audit trail for sample tracking, including a QA program to minimize erroneous data entry.
- Allow integration of new data.
- Document the database structure, code definitions, and means of accessing information.

A client-server database system is utilized for the management of Phase III data. The project database is stored and maintained on a Microsoft SQL Server database system (server) located in the ISSI Denver office. Wide area network access to the project database is provided via TCP/IP communications (Internet). Data entry and reporting are performed using a custom MS Access interface (client) developed by ISSI and tailored specifically for the Phase III Field Investigation. The Access tables store the data in a structure consisting of rows and columns. Relationships define how data in one table relate to data in another table. Queries store the framework for selecting subsets of data from tables. The database is constructed of data tables and reference, or "look-up" tables. A detailed description of the Project Database structure is presented in

The following outlines present a generalized structure of the data tables and field attributes for the project database.

For Properties Approved for Sampling:

Property Location Information

- House Number
- Street Name
- Neighborhood

Property Surface Soil Sample Information

- Building Type (Residential, School, Park, Alleyway)
- Depth of Sample
- Sample Type (Composite, Grab)

Property Indoor Dust Sample Information

- Number of Templates Collected
- Number of Templates Taken

All Media

- Chain-of-Custody Information
- Analytical Results
- Analysis and Sample Preparation Methods
- Laboratory and Validation Qualifiers

Access Agreement Tables

Owner Information Table

- Owner Contact Information
- Owner Language Preference

Access Agreement Letter Table

- Target Property Address
- Date Letter was Sent
- Status of Access Authorization (approved or denied)

5.8 Data Screening, Verification, and Validation

All documents received and catalogued by the DMT are subject to review. Two separate and distinct levels of document review are performed:

- Data Verification
- Data Validation

The following paragraphs describe the performance of these two levels of data review.

5.8.1 Data Verification

The term 'verification' refers to a review process in which data are checked for accuracy and completeness. The Project Database Manager and Field Activities Database Manager are responsible for overseeing this effort. Data verification will be performed on all original data (e.g., sample data collection sheets) to ensure that all information is correct. Any hardcopy or electronic data requiring modification as a result of the verification effort are returned to the source for amendment or correction. After the correction or amendment is complete, the data are then returned to the Project Database Manager or Field Activities Database Manager (as appropriate) and are re-verified to ensure that the appropriate corrections and/or amendments were performed correctly.

5.8.2 Data Validation

Data validation, as it pertains to database management, refers to a point-by-point comparison of the database with the primary data source (e.g., data collection sheets, COC forms, etc.). Database validation will be performed on all data transfers, however, the extent of that validation effort is dependent on how the data were compiled into the database.

Manual Data Entry

One hundred percent of all data entered onto a database table will be verified for accuracy. If corrections or amendments are required as a result of the review, this will be performed in accord with the details outlined in Section 5.9. After the correction or amendment is complete, the data are returned and points where corrections were requested are re-validated to ensure that the appropriate corrections and/or amendments were performed correctly.

Electronic Data Transfer

Twenty percent of all data that are transferred in electronic form will be verified for accuracy against the original hardcopy data. If corrections or amendments are required as a result of the

review, this will be performed in accord with the details outlined in Section 5.8.3. After the correction or amendment is complete, the data are returned and points where corrections were requested are re-validated to ensure that the appropriate corrections and/or amendments were performed correctly.

When errors in the data are observed, further verification of the electronic data is necessary. One hundred percent of the electronic data transfers that require correction will be verified for accuracy. If corrections or amendments are required as a result of the review, this will be performed in accord with the details outlined in Section 5.9. After the correction or amendment is complete, the data are returned and points where corrections were requested are re-validated to ensure that the appropriate corrections and/or amendments were performed correctly.

5.8.3 Data Amendment/Correction

The Data Amendment/Correction form (Figure 5-1) provides the mechanism to request changes to a document or electronic data record and provides an audit trail for subsequent data processing. Only data that have been transferred to the DMT may be submitted for amendment/correction. Changes to data requested as a result of data screening are routed to the Project Database Manager along with a Data Amendment/Correction form and a copy of the document requiring revision. The Project Database Manager assigns a request number to the form and logs it into the Document Control Database before forwarding the change order to the appropriate party.

[illegible]

5.9 Records Management

Data storage and security are critical aspects of data management. During the life of a project, all data developed as a consequence of field, laboratory, archival, and analytic investigations are under the direct control of the DMT. In the paragraphs that follow, descriptions are provided of the controls that the DMT uses for the storage, access, maintenance and security of project data.

5.9.1 Short-Term Records Management

Short-term records management is defined as the controlled storage of data in either hard copy or electronic formats during the active life of a project. Records management also includes the procedures and protocols that are used to control access and maintain physical security of project technical data. The following paragraphs describe the storage and security requirements for both hard copy and electronically formatted data files.

5.9.1.1 Hard copy Data Files

Two separate categories of hard copy files are identified for the management of project documents: Master Files and Project Files.

Master Files - The master files are the repository for original and amended copies of all project primary data, which include field forms, notebooks, maps, and laboratory data packages. These files also include any secondary and interpretive data that are considered important to the project decision-making process. These master files are stored in secure locations. These files as well as other administrative records are eventually transferred to, or are currently under the formal custody of the USEPA Records Center.

Project Files - The project files are in-house duplicate copies of the master files. Master files include all documents related to the project. In addition, they may contain copies of secondary and interpretive data documents. The project files are stored in locked file cabinets. These files are stamped "copy".

5.9.1.2 Electronic Data Files

In addition to hard copy versions of project technical data, the DMT is responsible for the electronic storage and maintenance of field and laboratory data. Because of the importance of these files to the overall decision-making process, considerable care is exercised by the DMT in the creation, maintenance, and security of the project's computerized database. The paragraphs that follow describe the procedures and protocols for electronic data entry, verification, maintenance and access/security.

Data Entry - Data entry includes both manual transfer of information from hard copy records and automated transfer from electronic files. Typically, manual data entry is used for field data and electronic transfer is used for laboratory data. Most data parameters are identified during project planning and therefore are systematically entered into the project database.

Data Verification - Typically, data entry makes use of only screened, verified, and validated records and, once data are entered, they are verified against those records for accuracy and completeness. The method used to verify the electronic record varies according to the means by which data are entered. The details of data verification are summarized in Section 5.8.1).

Database Maintenance - To ensure the integrity of the project database, the Systems Programmer/Analyst performs regular, periodic file maintenance activities. These include making daily backup copies of all database files to provide the means to restore them in the event of system failure or file corruption. A backup tape of the database files will also be stored off-site. Modifications to database structures are only performed at the direction or approval of the various investigators and data users. Changes to database structures are accommodated and documented by filing a Request for Data Services form with the DMT.

Database Access and Security - In order to minimize the potential for data corruption, access to the project database is password-protected. For example, as system administrator, only the Project Database Manager (or designee) is allowed to alter the structure of the database or its underlying programming. Project managers and technical personnel have read-only access to the database. They may perform on-line query or analyses of the data without restriction; however, they cannot alter the structure or content of the database. They may also request that the DMT provide hard copy summary reports or diskette copies of particular data sets. Files downloaded to project personnel are treated as derivative primary data and are not recorded in the Document Control Database. They also are not incorporated into the Master Document Files or the Project Files because they can be re-created from the project database.

5.9.2 Long Term Records Management

Data and records of data generated as a result of USEPA work assignments are the property of the USEPA. Long-term management of data files is outside of the responsibility of the DMT. Upon completion of the work assignment, Master Document Files as well as electronic copies of the Project Database and Document Control Database will be transferred to the custody of the USEPA Records Center.

6.0 REFERENCES

- ISSI. 1998a. Draft Final Project Plan for the Vasquez Boulevard And I-70 Residential Soils Supplemental Investigation: Physico-chemical Characterization of Soils. August 1998.
- ISSI. 1998b. Draft Data Report for the Vasquez Boulevard & I-70 Residential Soils Supplemental Investigation: Physico-Chemical Characterization of Soils. November 12, 1998.
- ISSI. 1999a. Selection of Chemicals of Potential Human Health Concern at the Vasquez Boulevard and I-70 Site. Memorandum to USEPA. June 18, 1999.
- ISSI. 1999b. Draft Report for the Vasquez Boulevard and I-70 Site Residential Risk-Based Sampling Stage I Investigation. Prepared by ISSI Consulting Group, Inc. April 1999.
- ISSI. 1999c. Phase III Investigation - Rationale for Collecting Surface Soil Samples Only. Memorandum to USEPA. June 18, 1999.
- ISSI. 1999d. Draft Project Plan for the Vasquez Boulevard & I-70 Site: Pilot-Scale Soil Characterization Study. June 1, 1999.
- UOS. 1998a. Final Sampling Activities Report for North Denver Residential Soils – Phase I. June 1998.
- UOS. 1998b. Sampling Analysis Report – Phase II Sampling for Removal Site Assessment. Vasquez Boulevard/Interstate 70 Site. September 21, 1998.
- USEPA. 1986. SW-846. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. September 1986 and all revisions.
- USEPA. 1992a. Supplemental Guidance to RAGS: Calculating the Concentration Term. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Publication 9285.7-081. May, 1992.
- USEPA. 1992b. Guidance for Data Usability in Risk Assessment. US Environmental Protection Agency, Office of Emergency and Remedial Response. Publication 9285.7-09A. April, 1992.
- USEPA. 1994a. Guidance for the Data Quality Objectives Process. Final. U.S. Environmental Protection Agency, Quality Assurance Management Staff. USEPA QA/G-4.

USEPA. 1994b. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. EPA Publication No. 9285.7-15-1.

USEPA. 1994c. Revised Interim Soil Lead Guidance for CERCLA and RCRA Corrective Action Facilities. Memorandum from Elliot P. Laws, Assistant Administrator, to Regional Administrators. OSWER Directive 9355.4-12. July 14, 1994.

USEPA. 1996. Quality Management Plan for the U.S. Environmental Protection Agency, Region 8. Version 1.0. Denver, CO.

USEPA. 1998a. USEPA Requirements for Quality Assurance Project Plans for Environmental Data Operations. Draft Interim Final. U.S. Environmental Protection Agency, Quality Assurance Management Staff. USEPA QA/R-5.

USEPA. 1998b. EPA QA/G-9 Guidance for the Data Quality Assessment Process: Practical Methods for Data Analysis. EPA/600/R-96/084. January 1998.

Appendix B

Waste Management Plan

Waste Management

The following will summarize the waste management approach to any Investigative Derived Waste (IDW) generated during project activities.

Regulatory Context

The project falls under the auspices of CERCLA. Consequently, federal regulations including the DOT, OSHA, CERCLA, RCRA and the state of Colorado's Solid Waste regulations will all be applicable to the VB I-70 project. At a minimum, the following regulations will be referred to in managing the waste at the site in a compliant manner:

- 49 CFR Subchapters A, B, C: Hazardous Material and Oil Transportation
- 40 CFR Subchapter 1: Solid Wastes
- 29 CFR 1910: Occupational Safety and Health
- CERCLA Off-site Rule: 40 CFR 300.440
- NCP: 40 CFR Part 300

The status of the generator will be based on the final waste status and waste quantity generated within one month. If the waste triggers CESQG, SQG or LQG status, Shaw will attempt to use the existing CO0002259588 CERCLIS ID # as the site specific ID#. If for some reason this not functional, Shaw will complete the necessary paperwork to obtain a onetime EPA ID# for the project site.

Waste Handling On Site

IDW soils will be generated on site in small increments. The IDW soils will be placed into 55 gallon open top drums as they are generated. Upon the first amount of soil being placed into a drum, Shaw will affix a "Contains Hazardous Waste" label pursuant 262.34(a)(3). The "accumulation start date" will be denoted on the label. In the event Shaw retrieves a representative sample to further characterize the IDW soils, and the tests demonstrate that the soils are not hazardous, a non hazardous label will replace the original hazardous waste label. The drums will be temporarily stored on site utilizing the 90 day storage without a permit provision.

Waste Characterizing and Profiling

Existing analytical from site delineation will be reviewed for potential use as characterization data. The delineation is in totals analysis. Totals waste analysis is a screening tool that can be used to determine if a waste does/does not exhibit the toxicity characteristic and whether to determine when the TCLP needs to be run. If the totals waste analysis exceeds twenty times the TCLP regulatory value (e.g. lead-D008) is

5.0 mg/L TCLP, and 20X that is 100 mg/kg for soil. If any of the delineation data points associated with the IDW soils exceed this 20x rule for lead and/or arsenic two waste management options exist. First, a representative sample is retrieved to run TCLP and substantiate the hazardous or non hazardous status of the waste or, secondly, based on the totals waste analysis concede/presume that the waste is hazardous and manage it accordingly. Factors that will be considered in making this decision are the quantity of waste, hazardous disposal cost versus non hazardous disposal cost and project schedule.

After the characterization of the IDW soils is accomplished, Shaw's Waste Management Specialist will assemble a Profile Package. This package will consist of waste analytical, profile, draft/final manifests, LDRs, CERCLA off-site notification from the EPA Region. This package will be submitted to the generator and technical representative within USACE for review. Upon any adjustments and final review the waste profile will be signed by the generator or legal representative. Shaw will then submit the profile package to the selected TSDF to obtain waste approval.

TSDF Selection

Shaw will conduct a formal solicitation of probable TSDFs able to accept the sites IDW soils. Both hazardous and non hazardous facilities will be considered until the waste is formally characterized. The primary factors and criteria in selecting the TSDF are as follows:

- Off Site Rule CERCLA approval status
- On site drum handling capability
- Disposal cost
- Transportation cost
- Practical acceptance criteria and permit conditions

Shaw will conduct this solicitation at the beginning of the project and summarize all of the available options for review by the generator and USACE. A mutual decision will be made on the TSDF to pursue and all sampling and analysis and waste handling will accommodate that particular facility's requirements.

Attachment 1

Forms



A large grid of graph paper with a 20x20 grid of squares. The grid is composed of small squares, each measuring 1 unit by 1 unit. The grid is used for plotting graphs and drawing geometric shapes.

Samples Collected by: _____ Signature _____ Date _____

Design Approved by: _____ Signature _____ Date _____

146543 VB/I-70 Investigation

Revision 2 8/7/2012

SURFACE SOIL DATA/CUSTODY FORM



PHASE:

MEDIUM:

SURFACE SOIL

SAMPLE COLLECTION METHOD:

DEPTH:

0-2 inches

Samples Shipped to Lab:

Date:

DATE:

Scribes™ Custody/Traffic Form Number:

SAMPLE TEAM ID:

Signature and Date:

ADDRESS:

House #

Street Name

BUILDING TYPE:

Residential

-

Single

(circle one)

Multifamily

Apartment

CLASS:

FS

(Field Sample)

SAMPLE NO:

SAMPLE TIME:

SAMPLE TYPE: (circle one)

First
SampleSecond
SampleThird
Sample

COMP

GRAB

COMP

GRAB

COMP

GRAB

GARDEN PRESENT?

Yes

No

Composite IDs-list below

IN USE?

Yes

No

ADDRESS CONFIRMED BY RESIDENT?

Yes

No

WILLING TO ALLOW FURTHER SAMPLING?

Yes

No

NOTES:

146543 VB/I-70 Investigation
PROPERTY DATA PACKAGE CHECK LIST



ADDRESS: _____ DATE SAMPLED: _____
House # Street Name

DESIGN APPROVED BY PROJECT CHEMIST/DESIGNEE: ☐ TEAM: _____

THREE COMPOSITES COLLECTED: ☐ FLOWER BED/GARDEN SEPERATELY: ☐

COMPOSITE 1 RESULT (mg/kg): Arsenic _____ Lead _____

COMPOSITE 2 RESULT (mg/kg): Arsenic _____ Lead _____

COMPOSITE 3 RESULT (mg/kg): Arsenic _____ Lead _____

PERCENT RSD <50: ☐ ☐

UCL-95 (mg/kg): Arsenic _____ Lead _____

COMPOSITE DUPLICATE?: _____ Arsenic _____ Lead _____

RPD <45: ☐

PROPERTY DECISION: CLEAN ☐ REMEDIATE ☐

FLOWER BED/GARDEN COMPS: _____

(mg/kg) Arsenic _____ Arsenic _____ Arsenic _____
circle if >action-level Lead _____ Lead _____ Lead _____

IF REMEDIATE, YEAR BUILT: _____ IF PRIOR TO 1978 ADDED TO LBP SURVEY LIST: ☐

DATA ENTERED INTO DATA-BASE: ☐

REVIEWED BY: _____ DATE: _____

12345678

CHAIN OF CUSTODY RECORD

Cooler #: 1

No: 8-080912-123235-0001

Lab: TestAmerica Laboratories Inc.

Lab Contact:

Lab Phone: 802-660-1990

[illegible]

Special Instructions: Example run	Shipment for Case Complete? N
	Samples Transferred From Chain of Custody #
Analysis Key: As=Arsenic, Pb=Lead	

[illegible]

Attachment 2

Standard Operating Procedures

From 1999 Document

Selected Standard Operating Procedures from 1999 Planning document

ISSI-VBI70-02 Residential Soil Sampling for Yards and Schools, and Parks-modified by Shaw 2012

ISSI-VBI70-05 Data Entry

MK-VBI70-07 Decontamination

MK-VBI70-04 Investigative Derived Waste Management



VB/I-70 Investigation Project-146543

Previous (1999) Standard Operating Procedure Modifications

SOP VBI70-02

Modified June 2012 – Guy Gallelo, Jr- Program Chemist

Properties will be sampled using the procedures contained in the attached SOP, ISSI-VBI70-02, *Residential Soil Sampling for Yards and School or Park Soils*, 1999 from the 1999 planning document. This amendment sheet to the SOP specifies any modifications being made to the referenced SOP in order to execute the task assigned. UFP-QAPP Worksheet 14 may also be referenced.

Section 4.1.3- Add new paragraph

Also identify and diagram any distinct flower beds and/or vegetable gardens. If a portion of the property is mostly planted in ornamentals it may be considered as a distinct flower bed area. Vegetable gardens are to be considered as distinct from any other areas or beds. Multiple similarly planted areas; such as raised/box beds in the same part of the yard can be considered as one distinct garden also. Flower bed/garden areas will not be included in the area calculations in section 4.1.4.

Section 4.1.5- Add new paragraph

For each distinct flower bed or garden area mark five (5) locations evenly spread through the area or one location per associated raised/box bed.

Section 4.1.6- Add new paragraph

Also place flags (five per distinct area/group of beds) in the flower bed/garden areas defined in the drawing. Move flags to avoid disturbing plants, irrigation/sprinkler lines, or landscape lighting wires. To avoid confusion use different colored flags for each area.

Section 4.1.7-Add new paragraph

Also collect the 5-point composites for each distinct flower bed/garden area identified. Each 5-point composite should be collected and placed into its own labeled zip bag.

Section 4.2-Section no longer required

Section 6.0

Delete last paragraph, no fine fraction is required. All samples will be sieved to #10 (2mm) size.

Forms-revised by Shaw June 2012, attached

[illegible]

Design Approved by: _____
Signature Date

146543 VB/I-70 Investigation

Revised 6/20/2012

SURFACE SOIL DATA/CUSTODY FORM



PHASE:

MEDIUM:

SURFACE SOIL

SAMPLE COLLECTION METHOD:

DEPTH:

0-2"

Samples Relinquished to XRF Lab by:

DATE:

Samples Accepted by XRF Lab:

SAMPLE TEAM ID:

(signature, date, time)

ADDRESS:

House #

Street Name

BUILDING TYPE:

Residential

-

Single

Multifamily

Apartment

CLASS:

FS

(Field Sample)

SAMPLE NO:

SAMPLE TIME:

SAMPLE TYPE: (circle one)

First
SampleSecond
SampleThird
Sample

COMP

GRAB

COMP

GRAB

COMP

GRAB

GARDEN PRESENT?

Yes

No

Composite IDs-list below

IN USE?

Yes

No

ADDRESS CONFIRMED BY RESIDENT?

Yes

No

WILLING TO ALLOW FURTHER SAMPLING?

Yes

No

NOTES:

Date: July 29, 1999 (Rev. # 1)

SOP No. ISSI-VBI70-02

Title: RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

APPROVALS:

Author _____ ISSI Consulting Group, Inc. _____

Original Date: June 14, 1999

SYNOPSIS: A standardized method for exposure-based residential yard, school or park surface soil sampling is described. Protocols for sample collection, compositing, and handling are provided.

Received by QA Unit:

REVIEWS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Region 8

Don L. Felt / RPM 7/29/99

ISSI Consulting Group, Inc.

J. Goldade / FQAC 7-29-99

Revision Date	Reason for Revision
July 29, 1999	Modified the definition of "samplable" areas to include regions where temporary obstructions are present. This will assure that both current and future land use is evaluated.

TECHNICAL STANDARD OPERATING PROCEDURE
RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a standardized method for residential yard, school, or park surface soil sampling, to be used by employees of USEPA Region 8, or contractors and subcontractors supporting USEPA Region 8 projects and tasks. This SOP describes the equipment and operations used for sampling residential yards, and school or park surface soils in areas which will produce data that can be used to support risk evaluations. Deviations from the procedures outlined in this document must be approved by the USEPA Region 8 Remedial Project Manager or Regional Toxicologist prior to initiation of the sampling activity.

2.0 RESPONSIBILITIES

The Field Project Leader (FPL) may be an USEPA employee or contractor who is responsible for overseeing the residential surface soil sampling activities. The FPL is also responsible for checking all work performed and verifying that the work satisfies the specific tasks outlined by this SOP and the Project Plan. It is the responsibility of the FPL to communicate with the Field Personnel regarding specific collection objectives and anticipated situations that require any deviation from the Project Plan. It is also the responsibility of the FPL to communicate the need for any deviations from the Project Plan with the appropriate USEPA Region 8 personnel (Remedial Project Manager or Regional Toxicologist).

Field personnel performing residential yard, and school or park soil sampling are responsible for adhering to the applicable tasks outlined in this procedure while collecting samples. The field personnel should have limited discretion with regard to collection procedures, but should exercise judgment regarding the exact location of the Sample Point, within the boundaries outlined by the FPL.

3.0 EQUIPMENT

- Soil augers - Various models of soil augers are acceptable and selection of the specific brand and make of tool will be recommended by the contractor implementing the field work (Morrison Knudsen Corporation). Augers are usually made of stainless steel, and should be capable of retrieving a cylindrical plug of soil 2 inches in diameter and 2 inches long. In all cases the procedures recommended by the manufacturers should be followed with regard to use of the auger. Augers with disposable plastic sleeves may be employed to minimize the decontamination effort.

TECHNICAL STANDARD OPERATING PROCEDURE
RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

- Collection containers - plastic zip-lock bags.
- Trowels - for extruding the soil from the auger. May be plastic or stainless steel.
- Compositing Bowl - for collecting the grab samples for compositing. Samples will be coarsely mixed in this bowl. May be plastic or stainless steel.
- Gloves - for personal protection and to prevent cross-contamination of samples. May be plastic or latex. Disposable, powderless.
- Field clothing and Personal Protective Equipment - as specified in the Health and Safety Plan.
- Sampling flags - three different colors or numbers (e.g., red, blue, and yellow). Used for identifying yard soil sampling locations. Each color or number represents a different composite sample.
- Wipes - disposable, paper or baby wipes. Used to clean and decontaminate marker flags.
- Field notebook - a bound book used to record progress of sampling effort and record any problems and field observations during sampling.
- Three-ring binder book - to store necessary forms used to record and track samples collected at the VBI70 site. Binders will contain the Surface Soil Data Sheet, Site Diagram, and sample labels for each day. Example forms are provided in Attachment 1.
- Permanent marking pen - used as needed during sampling and for documentation of field logbooks and data sheets.
- Measuring tape or wheel - used to measure each property.
- Measuring tape or pocket ruler - used to measure the length of soil core in the soil coring device.
- Trash Bag - used to dispose of gloves and wipes.

4.0 SAMPLING PATTERN

Sampling patterns for residential yard, school or park soils are designed to identify and collect

TECHNICAL STANDARD OPERATING PROCEDURE
RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

samples to support human health risk assessment. Idealized sampling patterns for residential soils are presented in the attached figures, but possible deviations from these sampling patterns could occur based on buildings or other obstructions found at each property. However, sample locations will be identified on a property-by-property basis. Proposed sampling patterns for the individual schools and parks will be provided as an attachment to the Phase III Field Investigation Project Plan at a later date.

4.1 RESIDENTIAL YARD SOIL

Residential yard soil samples will be composited, which requires soil collection from multiple (sub-sample) points. These soils are then mixed and used as a measure of the concentration averaged over the entire area (property). Surficial yard soil samples (0-2 inch depth) will be collected.

Soil Sample Location Identification

The surficial sampling locations within a yard will be based on a 30-point sampling grid. Because of the large number of properties that require sampling during this project, an independent chemical analysis will not be performed for each of the sub-samples collected from each property. Rather, three composite samples will be collected per residence, each consisting of 10 sub-samples that are identified by marker flags of the same color or number. Although numbers may be used for identification of sample locations, for the purposes of this SOP, all procedural descriptions will be illustrated using colored marker flags (e.g., 10 red, 10 blue, and 10 yellow). Identification of individual grab sample locations will be performed using the following general steps.

The team leader (TL) for each sampling team will be trained in this procedure in order to ensure replicable sample location assignment. The following steps will be followed (in order) prior to any sample collection:

- a. Measure each yard
 - b. Pace off each building or permanent obstruction
 - c. Identify major samplable areas
 - d. Determine the number of sample points in each subarea
 - e. Record sample locations
 - f. Mark sample locations
 - g. Collect the sample
-

TECHNICAL STANDARD OPERATING PROCEDURE
RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

4.1.1 Measure each yard

The TL will visit a residence at the time of sampling to assign the sampling scheme. The TL will measure the property dimensions with a measuring tape, measuring wheel or laser measuring device (± 0.5 feet). Draw a sketch of the property and record property dimensions, north orientation, and adjacent streets and alleyways on the site diagram.

4.1.2 Pace off each building or permanent obstruction

The TL will then pace off the major permanent structures of the residence (e.g., dimensions of the property boundary, house, garage, driveway, etc.) and prepare a site diagram to approximate scale (± 3 feet on each measurement). The goal is not have a drawing to scale, but instead to have an estimate of the total samplable area in the residential yard. The total samplable area is defined as any area on the property that is free of permanent obstructions. Temporary obstructions such as automobiles or trailers parked on unpaved property locations, picnic tables, plastic or other materials covering the property are not permanent structures and will be considered "samplable". Therefore, areas that could be used in the future if the temporary obstructions were removed, should be identified on the field diagram and must be considered in sample location identification. Figure 2 and Figure 3 provide examples of a typical residence at the VBI70 site that has been drawn on a grid.

4.1.3 Identify major samplable areas

For each residence, the samplable area will be divided into rectangular subareas, using natural boundaries such as the house, garage, sidewalk or gardens as division markers (See Figure 3). A minimum of three and a maximum of eight subareas will be identified to the nearest pace (± 3 ft). For convenience, it is recommended that the number of subareas identified is minimized. Draw the subareas on the site diagram sheet. Count the number of squares in each subarea and record this information on the field data sheet.

4.1.4 Determine the number of sample points in each subarea

Add the total number of squares contained in each of the subareas, and record in the appropriate space on the surface soil data sheet. Divide this number by 30 to determine the relative distance between each sample point, and record in the appropriate space on the data sheet (Attachment 1). To determine the number of sample points in each subarea, divide the number of squares in each subarea by the relative distance between sample points. Using standard analytical rounding procedures, round each number to the nearest whole number to determine the number of sample points in each subarea. (See Figure 3 for example).

TECHNICAL STANDARD OPERATING PROCEDURE
RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

4.1.5 Record sample locations

Before placing flags into the yard, mark their planned location on the site diagram. Marking flag locations on the site diagram before actually placing them will give the TL a chance to check that sample locations are evenly distributed within each subarea, and that 30 sub-sample locations are documented and recorded. In addition, if an error has occurred in the calculation of sub-sample locations, it will be discovered before any flags have been staked. Because property sizes and obstacles present at each residence may vary significantly, actual sample locations will be identified using a diagram that will be drawn for each individual property sampled. If either permanent or temporary obstructions are present at the intended sampling locations (e.g., sidewalk, shed, garden, etc.), the sample point should be offset so that a surficial yard soil may be collected, then the actual sample location must be correctly documented on the field diagram. If the TL identifies an error in the sample location identification procedures that compromise the readability of the document, a new, revised diagram may be necessary. After recording all of the sample points, the TL should check the site diagram to make sure that sub-sample locations are not clustered in any area (unless clustering is a result of offsetting sample locations due to obstructions). The TL should also verify that sample points are approximately equidistant throughout the property.

4.1.6 Mark sample locations

Starting at one corner of the property, stake sub-sample locations using a repeated sequence of three distinct flag types (i.e., Yellow, Blue, Red, Yellow, Blue, Red, etc.) in alternating sequence across subareas. Do not place the same flag types next to each other, so that there is an even distribution of flags in each subarea (Figure 3). As seen in Figure 3, the location of each marker flag should be approximately equidistant from the other flags within each subsection. Additionally, each color flag should be alternately placed so that the same color marker flags are not clustered. A sample location or flag may be reassigned if clustering is observed.

4.1.7 Surface Soil Collection

The first 10-point composite will be collected by combining the samples at flags of similar color (e.g., red). Grab samples will be collected from the 0-2 inch soil horizon adjacent to each marker flag. Each sample will be collected using a clean coring tool (2-inch diameter). Each grab sample marked by a red flag will be placed into a single zip-lock bag and labeled in accord with the most recent version of the Sample Identification and Tracking SOP (# ISSI-VBI70-01). The second and third 10-point composite samples will be collected in identical fashion but by sampling next to the blue and yellow flags, respectively.

4.2 SCHOOLS AND PARKS SOIL

Surface soil samples at schools and parks will be collected using the same sampling strategy as discussed for the residential soil sampling (Section 4.1). The number of grab samples collected

TECHNICAL STANDARD OPERATING PROCEDURE
RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

at an individual school or park may vary, but 3 composite samples will be collected at minimum. Each individual grab sample will be identified using marker flags of any three different colors (e.g., red, blue and yellow). The exact sampling pattern will be unique to the individual school or park and will be submitted as an attachment to the Project Plan at a later date. At minimum, each marker flag will be approximately equidistant from the other flags and each color flag should be alternately placed so that the same color marker flags are not clustered.

Decontaminate equipment as described in Section 9.0

5.0 COLLECTION OF COMPOSITE SAMPLES USING A CORING TOOL

A new pair of plastic gloves are to be worn in each Sampling Zone.

Locate the Sub-sample Point as specified by the TL and clean the area free of twigs, leaves, and other vegetative material that can be easily be removed by hand. If the specified sub-sample point is occupied by a rock, cobble or other hard object of sufficient size to be incapable of easy removal by hand, move the sub-sample point to a location closest to the original point.

Place the soil coring tool on the ground and position it vertically. Holding the tool handle with both hands, apply pressure sufficient to drive the tool approximately 2 inches into the ground while applying a slight twisting force to the coring tool. Remove the tool by pulling up on the handle while simultaneously applying a twisting force. If the sample was retrieved successfully, a plug of soil approximately two inches long should have been removed with the coring tool. If turf-like vegetation (lawn), is present at the sample location, the coring tool should be advanced through the sod and the root mass to the measured 2 inch interval as marked on the outside of the auger.

Hold the soil coring tool horizontally or place it on the ground. Using a clean spatula or knife, remove the soil collected at depth greater than two inches from the end of the sampling tool. Allow this soil to fall into the plastic bucket designated for excess soil material. Use a trowel to extrude the soil from the auger, pushing the two-inch soil plug from the coring tool so that it falls directly into the sample container. Repeat the steps outlined above until all of the sub-samples for each composite have been collected in the three sample containers.

Sample preparation homogenization will be performed in accord with the Sample Preparation SOP #MK-VBI70-05.

If sampling equipment is to be re-used, follow the decon procedures outlined in Section 9.0 before collecting the next composite sample.

6.0 SAMPLE CONTAINERS AND LABELING

Following the procedures outlined in Section 5.0, grab samples will be composited and then placed into sample containers (quart-sized plastic ziplock bags or larger). For each composite

TECHNICAL STANDARD OPERATING PROCEDURE
RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

sample, three sample identification labels are required. One label is placed on the Soil Collection Data Sheet (Attachment 1), one label is affixed to the quart-size bag containing the sample, and one label remains loose in the gallon-sized (or larger) ziplock bag which are reserved for sample preparation.

Sample labeling will occur as prescribed below:

- 1) Place the red pre-printed label ending with the “-R” onto the composite sample (See Sample Identification and Tracking SOP# ISSI-VBI70-01).
- 2) Place the blue pre-printed label ending with the “-R” onto the Soil Data Collection Sheet.
- 3) Place the third (green) pre-printed sample label ending with the “-B” designation onto another quart-sized zip-lock bag. There will be no sample in this bag, but it will be brought back to the field office unfilled and will serve as the sample container for the prepared sample sieved to <2 mm (bulk fraction).
- 4) This procedure will be repeated for the second and third composite samples collected at a property using clean zip-lock bags and unique sample ID numbers.
- 5) Place the 3 samples into a larger (gallon size) zip-lock bag that has been marked on the outside of the bag with the property address with permanent marker.

A percentage of samples will be selected for fine fraction (<250 μ m) analysis, as described in the Project Plan. Selected samples will be prepared in accord with the sample preparation SOP (No. MK-VBI70-05), and labeled with an “-F” designation written in permanent marker on the sample identification label.

7.0 SITE CLEAN-UP

Each hole made in the yard using the auger must be backfilled with clean topsoil and tamped down lightly. If sod was removed to obtain the soil sample, the hole should first be backfilled and then the grass plug be replaced by the field personnel.

If any rinse water used for sample decontamination is generated in the course of sample collection, it must be disposed of as specified in the SOP for Investigation Derived Waste Management (MK-VBI70-04). Wherever possible, sod and soil (not collected and retained as part of the composite sample) should be replaced in the same hole.

All 30 flags (if reused) should be decontaminated by wiping off with towels and/or baby wipes before re-use.

Throw all used wipes and gloves into the trash bags and take with you to dispose of at the field office.

8.0 RECORD KEEPING AND QUALITY CONTROL

TECHNICAL STANDARD OPERATING PROCEDURE
RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

Each field crew will carry a three-ring binder book that contains the surface soil data sheet, site diagram, and sample labels. In addition, a field notebook should be maintained by each individual or team that is collecting samples, as described in the Project Plan. At the end of each

day, the field crews will submit the site sketches and data sheets to the FPL. Each sampled property must have site sketches with sub areas and grab sample locations needed for 30 sub-samples, as described in Section 4.1. Deviations from this sampling plan should be noted in the field notebook, as necessary.

For each property, the notebook information must include:

- a. date
- b. time
- c. personnel
- d. weather conditions
- e. sample identification numbers that were used
- f. locations of any samples and sub-samples that could not be collected
- g. descriptions of any deviations to the Project Plan and the reason for the deviation.

Samples taken from soils with visible staining or other indications of non-homogeneous conditions should also be noted.

Field personnel will collect the proper type and quantity of quality control samples as prescribed in the Project Plan.

9.0 DECONTAMINATION

Because decontamination procedures are time consuming, having a quantity of sampling tools sufficient to require decontamination at a maximum of once per day is recommended. All sampling equipment must be decontaminated prior to reuse as prescribed in the Decontamination SOP (#MK-VBI70-07).

10.0 GLOSSARY

Project Plan - A written document that spells out the detailed site-specific procedures to be followed by the FPL and the field personnel.

Sample Point - The actual location at which the sample is taken. The dimensions of a sample Point are 2" in diameter and 2" deep (core technique) or 2" across by 2" deep (spoon/scoop technique).

Composite Sampling - A sample program in which multiple sub-sample points are compiled together and submitted for analysis as a single sample.

TECHNICAL STANDARD OPERATING PROCEDURE
RESIDENTIAL SOIL SAMPLING FOR YARDS, AND SCHOOL OR PARK SOILS

Sample zone - A unit of surface area subjected to a given sample program. A given zone usually is thought to contain similar metals concentrations or to be defined by a single set of exposure parameters.

11.0 REFERENCES

USEPA, 1995. Residential Sampling for Lead: Protocols for Dust and Soil Sampling, Final Report, EPA 747-R-95-001, USEPA, March 1995, 38 p.

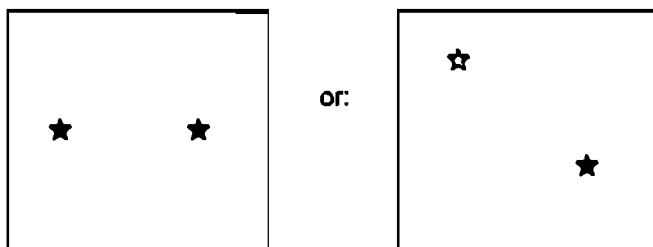
American Society for Testing and Materials, 1995. Standard Practice for Field Collection of Soil Samples for Lead Determination by Atomic Spectrometry Techniques, ASTM Designation: E 1727 - 95, October 1995, 3 p.

Figures and Attachment

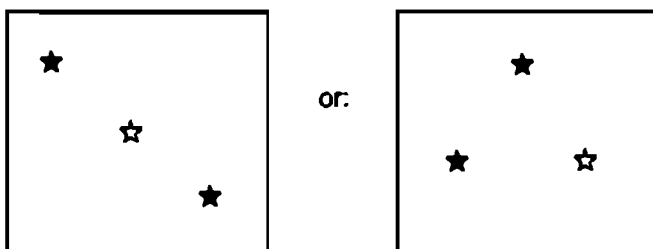
Figure 1

Idealized Sample Point Locations for Different-Sized Sample Areas

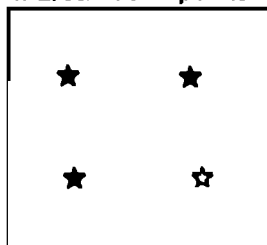
If area has 2 points:



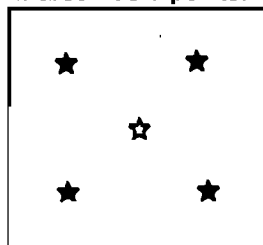
If area has 3 points:



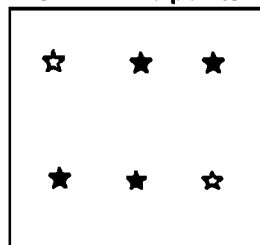
If area has 4 points:



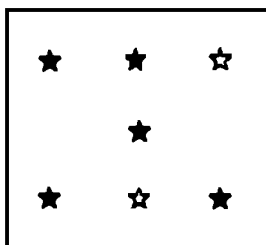
If area has 5 points:



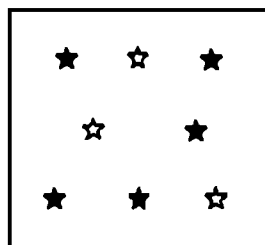
If area has 6 points:



If area has 7 points:



If area has 8 points:



If area has 9 points:

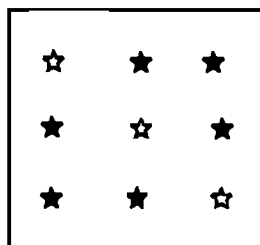


Figure 2 Proposed Grid Sampling Design for Residential Surface Soil

Step 1:

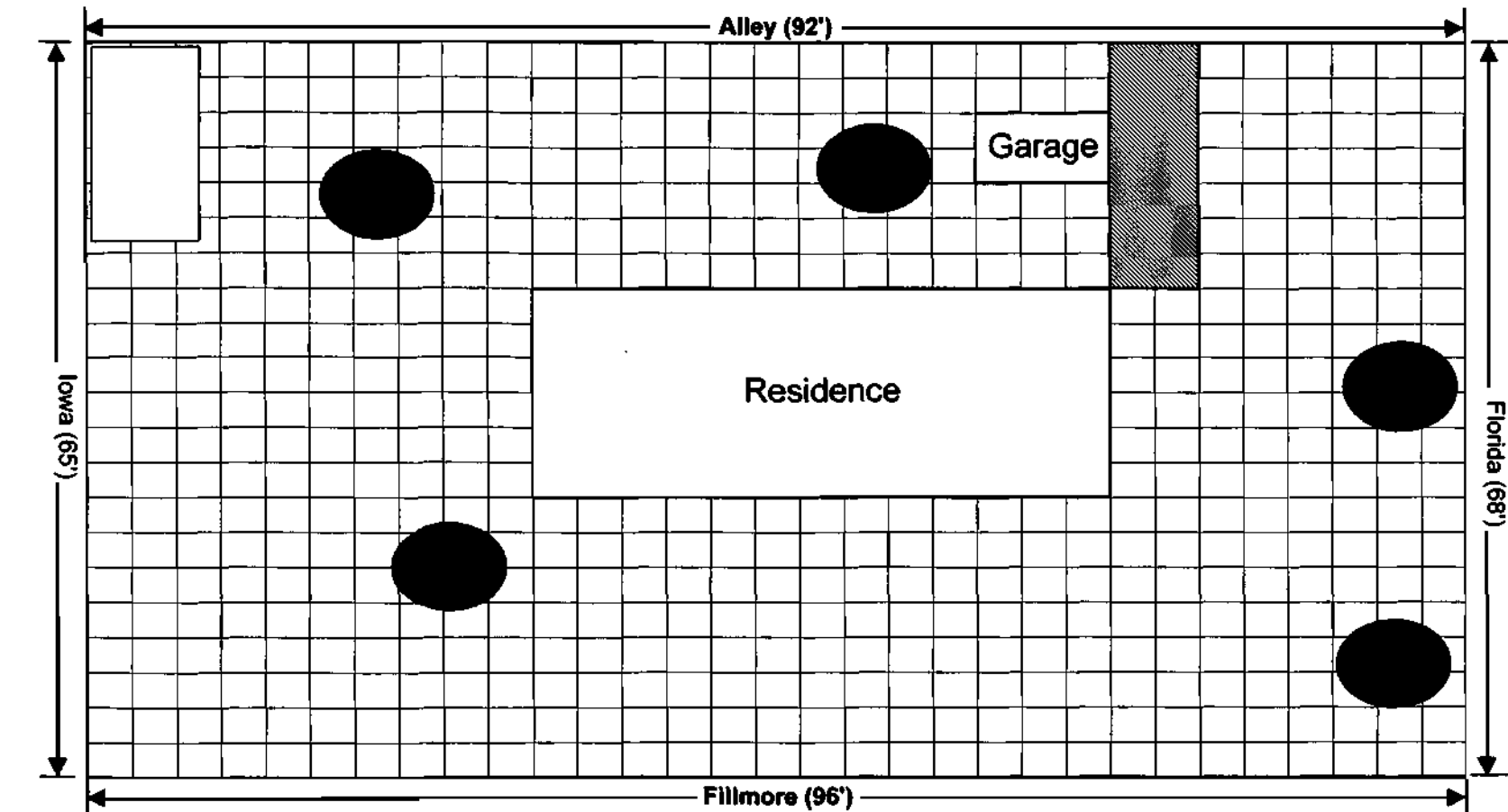
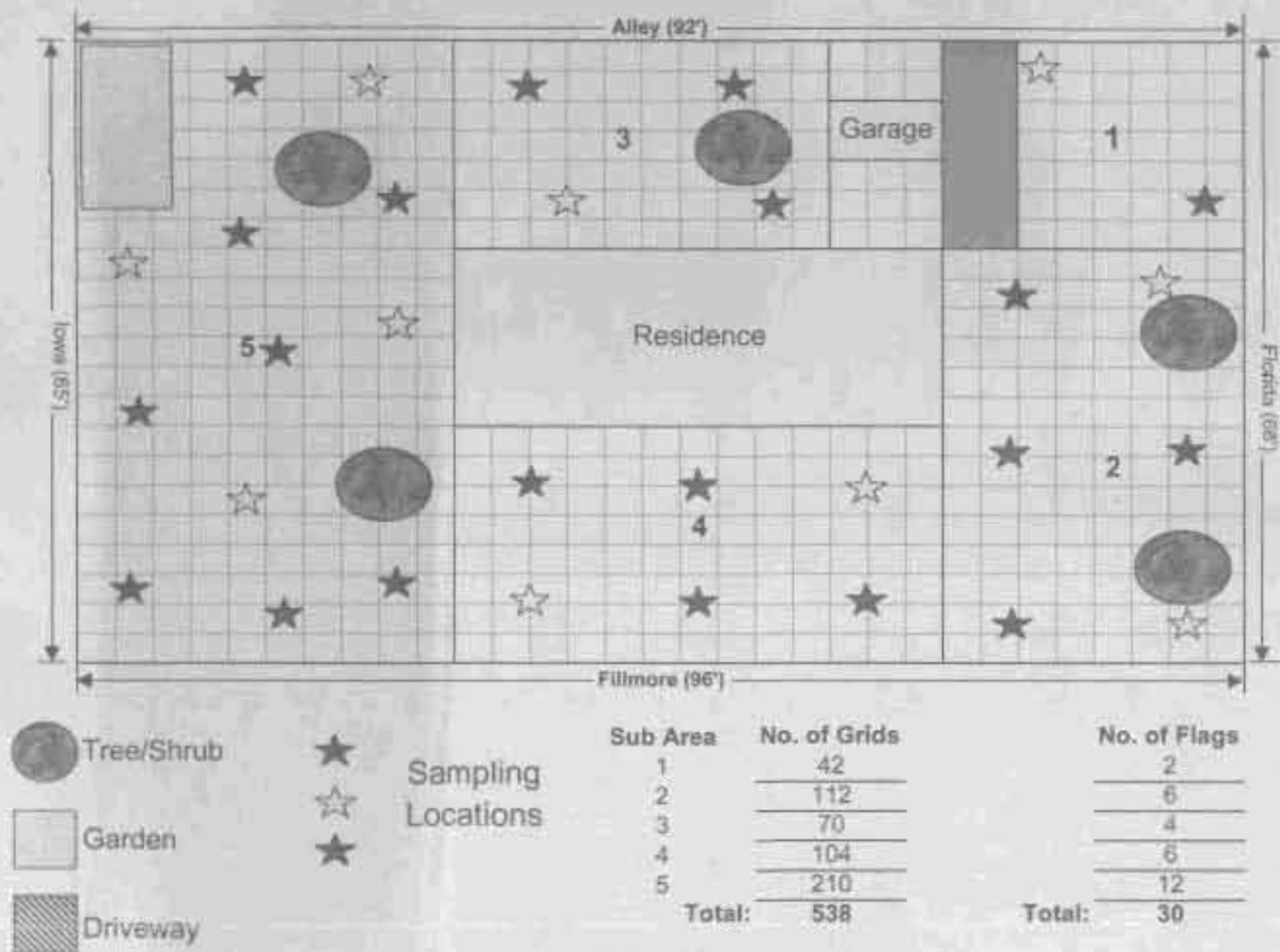


Figure 3 Proposed Grid Sampling Design for Residential Surface Soil

Step 2:



ATTACHMENT 1 SURFACE SOIL DATA SHEET

PHASE: 3MEDIUM: SURFACE SOILSAMPLE COLLECTION METHOD: ISSI-VBI70-02 Revision 1DEPTH: 0-2"

DATE: _____

SAMPLE TEAM ID: _____

ADDRESS: _____

House#
Street Name

BUILDING TYPE: Residential -- Single
 Multifamily
 Apartment

School (Name) -- _____

Park (Name) -- _____

CLASS: FS (Field Sample)

SAMPLE NO.:

SAMPLE TIME:

SAMPLE TYPE: (circle one)

First
Sample

COMP	GRAB
------	------

Second
Sample

COMP	GRAB
------	------

Third
Sample

COMP	GRAB
------	------

NOTES:

GARDEN PRESENT? _____ Yes

No

IN USE? _____ Yes

No

ADDRESS CONFIRMED BY RESIDENT? _____ Yes

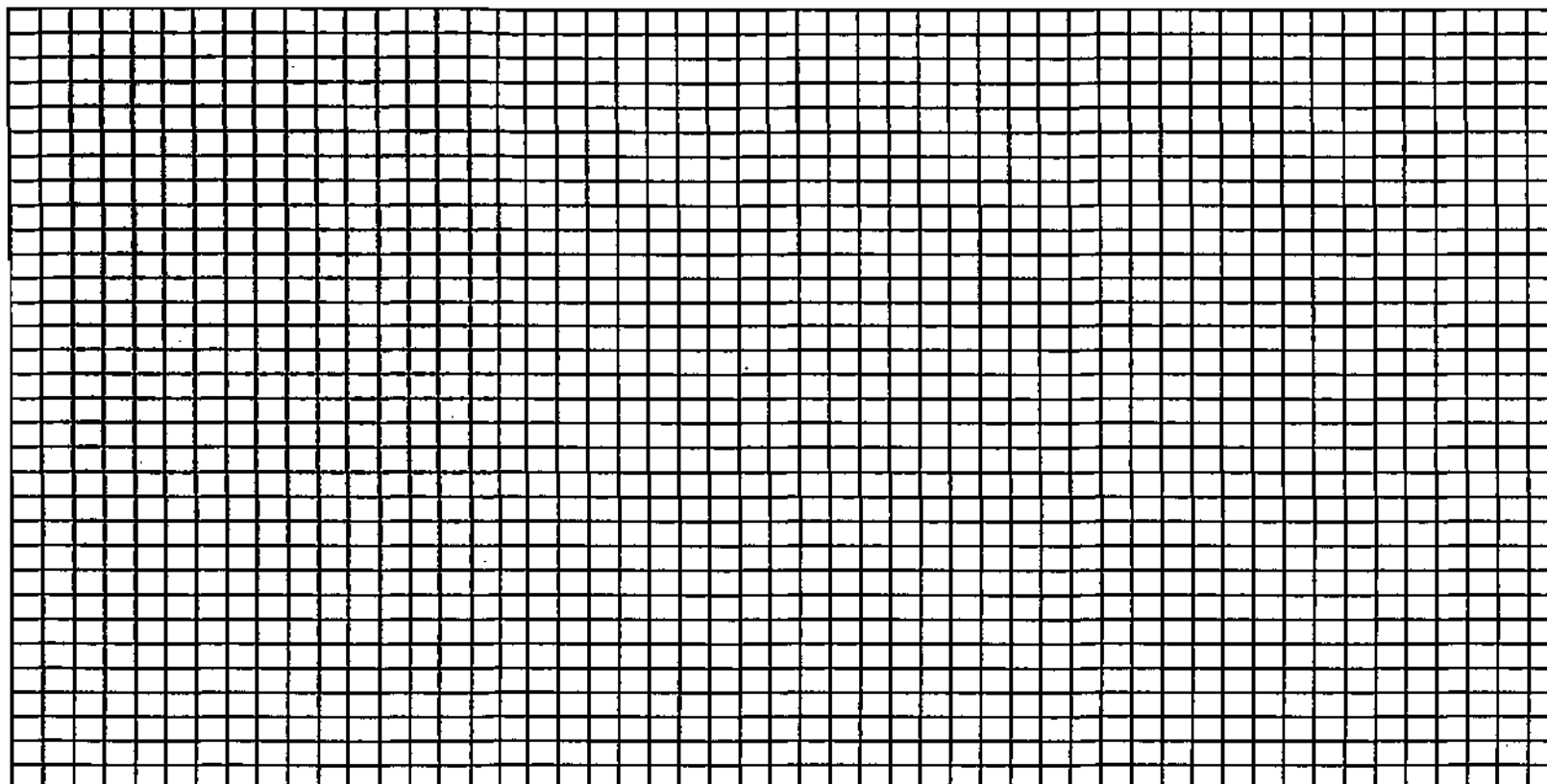
No

WILLING TO ALLOW FURTHER SAMPLING? _____ Yes

No

Field Diagram:

N



scale: 1 grid = 1 pace (~ 3 ft)

Sub Area	No. of Grids	Relative Dist. Between Samples (RDBS)	No. of Flags in Sub Area No. of Grids divided by the RDBS	No. of Each Flag (10 of each)
1	_____	Total Grids divided by 30 = _____	_____	Red _____
2	_____		_____	Blue _____
3	_____		_____	Yellow _____
4	_____		_____	
5	_____		_____	
6	_____		_____	
7	_____		_____	
8	_____		_____	
Total Grids: _____			Total Flags: _____	Equal to 30? Y N

Samples Collected by: _____
Signature Date

Logbook Page Reviewed by: _____
Signature Date

TECHNICAL STANDARD OPERATING PROCEDURE

Date: July 22, 1999 (Rev. # 0)

SOP No. ISSI-VBI70-05

Title: DATA ENTRY

APPROVALS:

Author ISSI Consulting Group, Inc. Date July 22, 1999

SYNOPSIS: Protocol for entering field data sheets, results of laboratory analysis and related field sampling documentation into the project database.

Received by QA Unit:

REVIEWS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

USEPA Region 8

Bonnie Frank / RPN

8/5/99

ISSI Consulting Group, Inc.

W. Volante / FQAC

8.5.99

For Doug Weiner

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide a standard method for entering field observations and results of laboratory analysis into the project database. Sources of these data include field data sheets, laboratory preparation logsheets, laboratory analytical results, and sample chain-of-custody forms generated during execution of the VBI70 Phase III site investigation. This protocol will be implemented by employees of USEPA Region 8 or contractors and subcontractors supporting Region 8 projects and tasks.

2.0 RESPONSIBILITIES

Individual and organizational responsibilities for data management personnel are described in the Data Management Plan.

The Field Activities Database Manager is responsible for overseeing the accurate and complete population and maintenance of the computerized database used to electronically store and process data obtained during field collection activities. The Field Activities Database Manager is responsible for verification of electronic data entry and maintenance of hard copy forms and logbooks. The Field Activities Database Manager is also responsible for implementation of the electronic database and document security.

Technical difficulties encountered or questions regarding the operation of database applications software are directed to the Project Database Manager. It is also the responsibility of the Project Database Manager or designee to schedule and perform installation and training for the project data entry prior to the initiation of field activities. Subsequent installation, upgrades and training may be necessary to address future project requirements and system enhancements.

It is the responsibility of the Field Activities Database Manager to identify any deviations from the SOP that may be required and to obtain approval for these deviations from the USEPA Region 8 Remedial Project Manager or the USEPA Technical Contact for Data Management/GIS prior to initiation of any data entry activities that are not in accord with this SOP.

TECHNICAL STANDARD OPERATING PROCEDURE
DATA ENTRY

3.0 DATABASE MANAGEMENT SYSTEM

3.1 Overview

A client-server database system is utilized for the management of Phase III data. The project database is stored and maintained on an MS SQL Server database system (server) located in the ISSI Denver office. Wide area network access to the project database is provided via TCP/IP communications (Internet). Data entry and reporting are performed using a custom MS Access interface (client) developed by ISSI and tailored specifically for the Phase III investigation. A detailed overview of the project database is presented in the Data Management Plan.

3.2 System Requirements

Software:	MS Access 97 SQL Server Client Software (ISSI Provided)
Operating System(s):	MS Windows 95 / MS Windows 98 / MS Windows NT
Hardware Requirements:	Pentium Grade PC 16MB Random Access Memory (Minimum RAM) Super VGA video resolution (800 x 600) 50MB Hard Disk Space
Internet Communications:	Internet Service Provider (ISP) 56kb or faster communications rate

Table 1 – System Requirements

3.3 Installation

The Project Database Manager will coordinate with the Field Activities Database Manager to schedule installation and remote site testing of the data entry and reporting interface. Installation and testing of the database client interface will be performed by the Project Database Manager or designee prior to initiation of field sampling and data collection activities.

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

3.4 Training

The Project Database Manager will coordinate with the Field Activities Database Manager to schedule training for data management personnel. Training will be performed prior to initiation of field sampling and data collection activities.

4.0 DATA ENTRY PROTOCOL

4.1 Overview

This protocol is to be used for entering data from field data collection sheets, laboratory preparation logsheets, results of laboratory analysis, and information contained on the chain-of-custody form into the project database. Specifically, this SOP addresses entering data from the following data sources:

- Surface Soil Data Sheets
- Alleyway Soil Data Sheets
- Indoor Dust Data Sheets
- Field Sample Preparation Logbook Sheets

Additional data may be entered from the hardbound notebooks maintained by the field sampling crews.

At the completion of each day's sample collection activities, the field data sheets are screened for legibility and completeness by the Field Project Leader or designate. Following verification the field forms and copies of the associated chain-of-custody forms are forwarded to the appropriate Field Activities Database Manager for entry into the project database. The Data Entry Clerk enters the information contained on the forms into the project database and generates a hard copy report of the newly entered data. The hard copy report is then verified for accuracy in accordance with the protocol described in Section 5.8 of the Data Management Plan. Data entry verification reports are stored as described in Section 5.9 of the Data Management Plan.

Results of laboratory analysis may be imported electronically into the project database, or alternatively, manually entered from hard copy laboratory reports. Analytical results should be transferred or entered as soon as results are available. Electronically imported data records are verified for accuracy in accordance with Section 5.8 of the Data Management Plan.

4.2 SQL Server Login

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

The database client interface is initiated by double clicking on the VBI70 Database icon. The user is prompted for a SQL Server Login ID and password. Login IDs and passwords for data management personnel will be provided on request by the Project Database Manager.

4.3 Menu Operation

A menu system is provided to assist users in navigating through the data entry and reporting interface (Figure 1). Menu items that reference sub-menus are denoted with a right-arrow symbol (=>).

Data entry screens are accessed by selecting the "Data Maintenance" menu option from the Main Menu. To navigate the menu, use the up and down arrow keys to highlight the menu choice and press the <Enter> key, or position and click the mouse pointer over the menu selection.

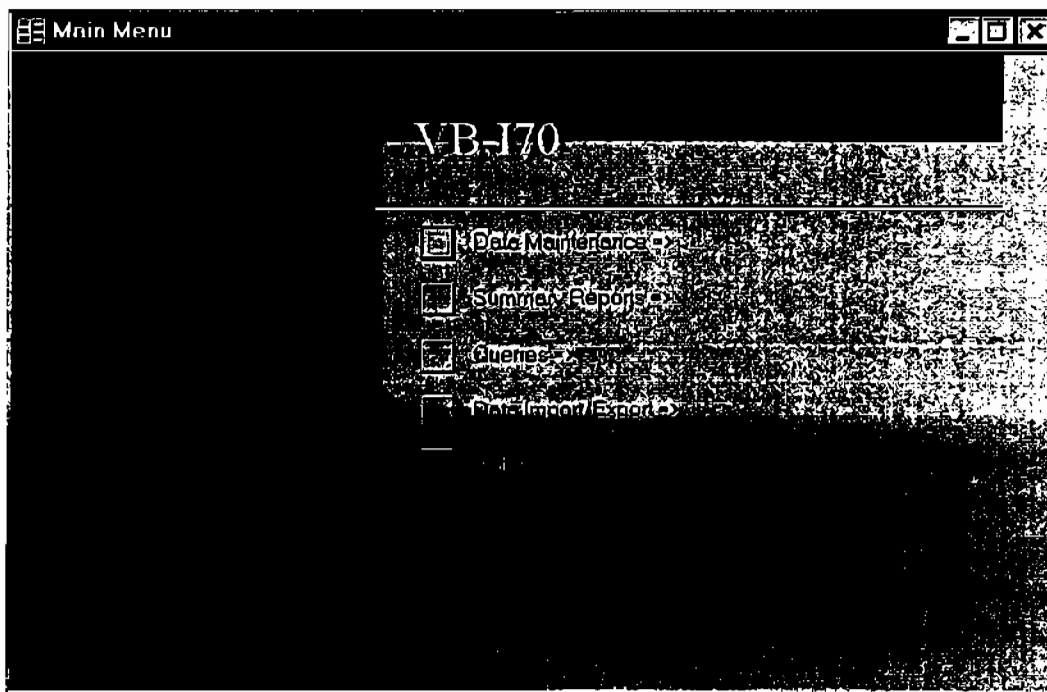


Figure 1 – Main Menu

4.4 Entering Field Data Sheets

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

The VBI70 database interface utilizes standard MS Access conventions for entering, finding, filtering, and viewing data. Please refer to the MS Access software documentation for a complete reference of keyboard shortcuts and application functionality.

Data entry screens are arranged to prompt for information in the same order as the information is recorded on the field data sheets. A typical data entry screen (Property Surface Soil Samples) is presented in Figure 2.

Drop-down Fields

Certain data entry fields are restricted to a valid list of values. These fields are identified by a small down-arrow located at the right hand side of the data field. To enter a valid value in one of the drop-down fields, enter the appropriate code and then press the <Tab> key to move the cursor to the next field. To display a full list of valid values, mouse click on the small down-arrow located at the right end of the drop-down field.

Property Surface Soil Samples

Phase: 3 (Phase III)

Medium: SS

Collection Method: ISSI01.0 (ISSI-VBI70-01: Rev. 0)

Depth (ft): 0

Depth (in): 2

Date and Time: 7/27/99

Team: MK01 (MK Team #1)

Address: 1231 MARTIN LUTHER KING BLVD

Building Type: PK (Park)

Sample ID: 3-00001-R

Sample Type: FS (Field Sample)

Sample Location: Composite Sample

Sample Status: R (Raw Unprocessed)

Buttons: Find, Filter, Print, Save, Close

Page: 1

Figure 2 – Surface Soil Data Entry Screen

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

For example: to enter a “composite” sample type, type the code “CP” in the sample type field and press enter, or select “Composite” from the drop-down list. After entering a valid code, both the code and code description are displayed in the entry field for clarity.

Fields with a light gray background appearance are “Read Only” fields, meaning that the data displayed in the field cannot be changed.

The footer or bottom-most section of the form contains a set of command buttons. The following standard conventions apply to the Surface Soil, Alleyway Soil and Indoor Dust data entry screen command buttons:

[Add] - Appends a new sample.

[Add Next] - The database is organized with one data record for each sample. Surface Soil and Alleyway data sheets are designed to record more than one sample per data sheet. The [Add Next] command button is provided as a convenient way to carry over common sample information to the next data record. The cursor is then positioned on the Sample Number field of the new data record for entering the next sample number of the set.

[Delete] - Deletes the current sample record. Sample records cannot be deleted if Test or Laboratory Results information exists for the sample.

[Save] - Saves changes to the data record. Changes are automatically saved when a new record is added.

[Undo] - If changes haven't been saved, the [Undo] command button will restore the data entry fields to their initial state.

[Tests...] - Launches laboratory data entry screens. Entering laboratory information is described in following sections.

[Close] - Exits the data entry form and returns control to the menu system.

4.5 Valid Value Reference Tables

The valid value reference, or “lookup” tables may be accessed from the Main Menu by selecting “Data Maintenance =>”, “Lookup Tables =>” and then either “Field Data Lookup Tables =>” or “Laboratory Data Lookup Tables”. Certain lookup tables may only be accessed for **read-only** purposes. Additions or changes to the read-only valid

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

values may be requested by submitting a Data Amendment/Correction Form to the Data Services Manager as described in Section 5.8 of the Data Management Plan.

4.6 Entry of Surface Soil Data Sheets

From the Main Menu, select "Data Maintenance =>", "Property Sampling =>", "Add/Edit Surface Soil Samples".

The following information is entered from the Surface Soil Data Sheet for each sample collected:

Field Name	Data Entry Instructions
Phase	Defaults to code "3", Phase III Sampling
Medium	Defaults to code "SS", Surface Soil Sampling
Sample Collection Method	Defaults to "ISSI-VBI70-02 Rev. 1"
Depth Top (in)	Defaults to 0"
Depth Bottom (in)	Defaults to 2"
Sample Date and Time	Enter the Sampling Date. Sample Time is optional. Entry Format: MM/DD/YY 24:00
Sample Team ID	Valid value list
Address	Valid value list
Building Type	Valid value list
Sample Number	Enter the Sample Number
Class	Defaults to "FS" for yard soil samples
Parent Sample	Not required for Class "FS". Indicates the sample number associated with a duplicate field QC sample.
Sample Type	Defaults to "COMP" for composite samples
Sample Fraction	Defaults to "R" for raw samples

The Surface Soil Sample data entry screen has an additional command button labeled [Property...]. This button calls up the Property Access Agreement record for the selected property address. The purpose of this button is to record answers to the following questions posed on the Surface Soil Data Sheet:

- Is there a garden present?
- Is the garden currently in use?
- Has the address been confirmed by the resident?
- Is the resident willing to allow further sampling?

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

After completing the entry of all sample information, select the [Tests...] command button. Enter the requested analyses as described in the following section.

Select the [Add Next] command button to carry over information to the next sample collected at the same address, or select the [Add] command button to enter data for a new property address. Select the [Close] button to return to the menu system.

4.7 Entry of Tests (Required Analysis) Information

Data entry screens for samples of each medium include a command button to access the analytical requests (tests) and analytical results information. Analytical requests are listed for each sample on the sample chain-of-custody form. Select the [Tests...] command button to enter analytical requests. The data entry screen for entering laboratory analyses and results information is presented in Figure 3.

Create one entry for each laboratory analysis required as indicated on the sample chain-of-custody form. For example, enter test "XRF-MK" to select the "As and Pb by XRF" analytical request.

For each laboratory analysis required, enter the chain-of-custody ID and select the appropriate laboratory ID.

All other information will be entered and provided by the laboratory performing the analysis. Select the [Close] button to save the information and return to sample data entry screen.

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

Tests / Results

Sample No.: 3-00001-R

Date and Time: 12/12/12

Sample Type: FS - Field

Tests

Test	Test Description	Coc No	Tag
AS	AS, PB by XRF		
XRF-B	AS, PB by XRF		
XRF-F	AS, PB by XRF		

Results

Test	Parameter	Method	Result	C Flg	Q Flg	Units	MDL	Dilution

Close

Figure 3 – Laboratory and Results Entry Screen

4.8 Entry of Alleyway Soil Data Sheets

From the Main Menu, select "Data Maintenance =>", "Alleyway Sampling =>", "Add/Edit Alleyway Soil Samples".

The following information is entered from the Alleyway Soil Data Sheet for each sample collected:

Field Name	Data Entry Instructions
Phase	Defaults to code "3", Phase III Sampling
Medium	Defaults to code "AW", Alleyway Soil Sample
Sample Date and Time	Enter the sampling date. Sample time is optional.
Depth Top (in)	Defaults to 0"
Depth Bottom (in)	Defaults to 2"
Alleyway ID	Valid value list. Note: Alleyway IDs and Map Positions will be assigned in the mapping process.
Sample Collection Method	Defaults to "ISSI-VBI70-03 Rev. 0"

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

Sample Team ID	Valid value list
Map Position	Enter the Map Position as indicated on the data sheet
Sample Number	Enter the Sample Number as indicated
Class	Enter the Sample Class, "FS" for Routine Field Samples or "FD" for Field Duplicates
Parent Sample	Enter the Original Sample Number for Class "FD", or Field Duplicate samples. Not required for Class "FS" samples
Sample Type	Defaults to "GRAB" for grab samples
Sample Fraction	Defaults to "R" for raw samples

Figure 4 – Alleyway Surface Soil Sampling

Select the [Tests...] command button to enter required analysis information as described in Section 4.7.

Select the [Add Next] command button to carry over information to the next sample collected at the alleyway, or select the [Add] command button to enter data for a new alleyway location. Select the [Close] button to return to the menu system.

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

4.9 Entry of Indoor Dust Data Sheets

From the Main Menu, select "Data Maintenance =>", "Property Sampling =>", "Add/Edit Indoor Dust Samples". The data entry screen for indoor dust sampling is presented in Figure 5.

The following information is entered from the Indoor Dust Data Sheet for each sample collected:

Field Name	Data Entry Instructions
Phase	Defaults to code "3", Phase III Sampling
Medium	Defaults to code "HD", Household Dust Sampling
Sample Collection Method	Defaults to "ISSI-VBI70-04 Rev. 0"
Sample Date and Time	Enter the Sampling Date. Sample Time is optional. Entry Format: MM/DD/YY 24:00
Sample Team ID	Valid value list
Address	Valid value list
Sample Number	Enter the Sample Number as indicated
Class	"FS" for Field Sample or "EB" for Equipment Blank
Parent Sample	Not required for Class "FS". Indicates the sample number associated with a duplicate field QC sample.
Sample Type	Defaults to "COMP" for composite samples.

For each template location, enter the Living Area Code, Surface Type Code and any notes as indicated on the Indoor Dust field data sheet.

Select the [Tests...] command button to enter required analysis information as described in Section 4.7.

Select the [Close] button to return to the menu system.

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

Temp #	Area Code	Surf. Type	Notes
1	BR	S	
2	FR	S	
3	K	H	
4	E	H	

Figure 5 – Indoor Dust Data Entry Screen

4.10 Entry of Field Sample Preparation Logbook Sheets

The procedure for entering surface soil samples listed on the Field Sample Preparation Logbook Sheet is similar to that of the Surface Soil and Alleyway Soil data sheets. The samples listed on this log will all have a sample number suffix of either “-B” or “-F”, representing the “Bulk” and “Fine” fraction of the “Raw” or “-R” sample. This procedure requires that the raw (-R) sample information be entered from either the Surface Soil or Alleyway Soil field data sheets before the Bulk or Fine fraction samples are entered from the Field Sample Preparation Logbook sheet.

The data entry process begins by finding the associated “-R” sample in the database. Enter the Surface Soil Samples data entry screen by selecting “Data Maintenance =>”, “Property Sampling =>”, “Add/Edit Surface Soil Samples” from the Main Menu.

To find the raw sample in the database, position the cursor in the “Sample No.” field and press <Ctrl-F>, or click on the binoculars icon on the tool bar at the top of the screen.

TECHNICAL STANDARD OPERATING PROCEDURE

DATA ENTRY

Check that the find options are set to search all records, to match any part of the field and to search only the current field (Figure 6). Enter the raw sample number in the Find What field; i.e.: 3-00001-R, and then click on the "Find First" command button to retrieve the raw sample information. If the sample is found, select the "Add Next" command button to carry over the raw sample information to the new "Bulk" or "Fine" sample entry. If the sample is not found, look for the sample using the Alleyway Soil Sample data entry screen.

Click on the "Tests..." command button to enter the requested analysis information from the laboratory prepared chain-of-custody. The procedure for entering requested analysis information is described in Section 4.7.

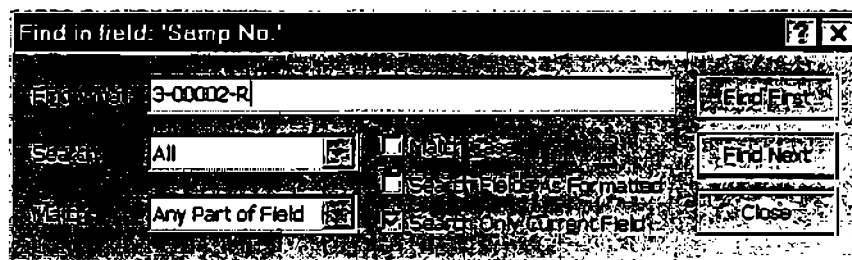


Figure 6

TECHNICAL STANDARD OPERATING PROCEDURE

Date: July 15, 1999

SOP No. MK-VBI70-07

Title: **Decontamination**

APPROVALS:

Morrison Knudsen Corporation

Author: Maria Valent

Date: July 15, 1999

SYNOPSIS: Provides procedures and instructions for decontamination of sampling equipment and field personnel.

Received by QA Unit

REVIEWS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Region 8

Bonnie J. L. / RPM

7/24/99

Morrison Knudsen Corp.

Ellen McE / Field QA Coordinator

7/16/99

REV.	DATE	REVISION DESCRIPTION



MORRISON KNUDSEN CORPORATION
Response Action Contract No. 68-W7-0039

SOP No. MK-VBI70-07
Revision No. 0
Page 1 of 3

TECHNICAL STANDARD OPERATING PROCEDURE DECONTAMINATION

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide instructions for decontamination of sampling equipment and field personnel. Decontamination is necessary to protect personnel and to minimize the potential for cross-contamination of samples. This procedure is to be used by MK employees assigned to the Vasquez Boulevard/I-70 project and their subcontractors.

2.0 SCOPE

This procedure covers activities associated with decontamination of sample equipment and personnel. Additional requirements for personnel decontamination may be specified in the Site Health and Safety Plan.

3.0 RESPONSIBILITIES

All Field Personnel will be responsible for performing personal and equipment decontamination after sampling at each location and at the end of the day in accordance with these procedures.

The Field Supervisor will be responsible for training field personnel in appropriate decontamination procedures as well as verifying implementation of this procedure through surveillance.

The Site Manager will be responsible for ensuring that all personnel are trained to this procedure.

4.0 DECONTAMINATION

4.1 Personnel will remove disposable gloves following collection of each sample. Gloves will be contained in a plastic bag and disposed as municipal waste. All personnel and clothing will be inspected following sample collection at each property and, if necessary, decontaminated to remove any potential harmful substances that may have adhered to



TECHNICAL STANDARD OPERATING PROCEDURE DECONTAMINATION

them. Disposable, pre-moistened wipes will be available for personnel to wash their face and hands.

- 4.2 The equipment used for sample collection, including hand augers, bowls and trowels, will be decontaminated between samples collected for separate composites, between samples collected for discrete sampling and analysis, and following the last sample collection daily. Sampling equipment and tools will be decontaminated immediately following sample collection at the location/property from which the sample was collected by the following procedure:
- Wash with a low- or non-phosphate detergent and tap water using a brush as necessary
 - Triple rinsed with deionized water
 - After decontamination, equipment and tools will be protected by placing them in clean containers and taking care not to allow contact with surface soils
- 4.3 Sample preparation tools, including drying pans, sieves, and spatulas, will be decontaminated between samples by the following procedure:
- Wash with a low- or non-phosphate detergent and tap water
 - Triple rinse with deionized water
 - After decontamination, equipment and tools will be protected by placing them in clean containers and taking care not to allow contact with surface soils
- 4.4 Rinsate blanks will be collected at a rate of 5% (one in twenty decontaminations). The rinsate blank will be collected by pouring deionized water over decontaminated equipment and collecting the rinsate in a 500-mL certified clean polyethylene bottle. The sample will be preserved using nitric acid to pH<2, and submitted to an off-site laboratory for total arsenic and lead analyses.
- 4.5 Decontamination rinsate will be disposed in accordance with the Technical Standard Operating Procedure for Investigation Derived Waste Management.



TECHNICAL STANDARD OPERATING PROCEDURE

Date: July 15, 1999

SOP No. MK-VBI70-04

Title: **Investigation Derived Waste Management**

APPROVALS:

Morrison Knudsen Corporation

Author: Maria Valente

Date: July 15, 1999

SYNOPSIS: Provides procedures to manage investigation derived wastes.

Received by QA Unit

REVIEWS:

TEAM MEMBER

SIGNATURE/TITLE

DATE

EPA Region 8

Bonita Smith / RPM

7/24/99

Morrison Knudsen Corp.

Ellen J. White / QA Coordinator

7/16/99

REV.	DATE	REVISION DESCRIPTION



TECHNICAL STANDARD OPERATING PROCEDURE INVESTIGATION DERIVED WASTE MANAGEMENT

1.0 PURPOSE

The purpose of this procedure is to describe the methods that will be used by Morrison Knudsen personnel assigned to the VB/I-70 project and their subcontractors to manage investigation derived wastes (IDW).

2.0 SCOPE

This procedure covers management of all IDW, including trash, soils, water, and personal protective equipment (PPE). Management procedures include waste collection, segregation, characterization, storage, shipping and disposal, as appropriate for each waste stream.

3.0 REFERENCES

Management of Investigation-Derived Wastes During Site Inspections, EPA/540/G-91/009

Code of Federal Regulations, Chapter 50, Parts 262 and 265.

4.0 DEFINITIONS

DOT: Department of Transportation

IDW: Investigation Derived Waste

PPE: Personal Protection Equipment

5.0 RESPONSIBILITIES

All **Field Personnel** will be responsible for managing IDW in accordance with this procedure.

The **Field Supervisor** will be responsible for training field personnel to the requirements of this plan, verifying its implementation, and generating and maintaining required records.



TECHNICAL STANDARD OPERATING PROCEDURE INVESTIGATION DERIVED WASTE MANAGEMENT

The **Site Manager** will be responsible for ensuring that personnel are properly trained and providing guidance for any special circumstances that may arise.

6.0 EQUIPMENT

- DOT compliant containers as specified in 40 CFR 265 Subpart I.
- Non-hazardous (and if necessary Hazardous) Waste Labels
- Spill Control Materials

7.0 REQUIREMENTS

7.1 General

All IDW will be managed in accordance with federal, state, and local rules and regulations. Personnel responsible for hazardous waste labeling, inspecting, profiling, manifesting, and transportation preparation will be trained per 29 CFR 1910.120 and 49 CFR 172.704.

7.2 Waste Types

Waste streams anticipated to be generated during the work activities include:

- Raw fraction soils and vegetation
- Bulk and fine fraction soil
- Disposable gloves and other personal protection equipment (PPE)
- Decontamination rinsate generated at residential properties
- Decontamination rinsate generated at the field office/laboratory
- Trash

7.2.1 Raw Fraction Soils and Vegetation - The large fraction soils and vegetation will be separated from the fine fraction soils during sample collection, preparation and sieving procedures. Large fraction soils or vegetation, including sod, generated at individual residential properties should be left at the property in the vicinity of the sample location(s). Large fraction soils or vegetation generated during sample preparation at the



TECHNICAL STANDARD OPERATING PROCEDURE INVESTIGATION DERIVED WASTE MANAGEMENT

field office/laboratory will be contained and stored in drums pending profiling and disposal as described below.

- 7.2.2 **Bulk and Fine Fraction Soil** - Bulk and fine fraction soils will be generated at the field office/laboratory by the sample preparation process. Any portion of the prepared soils that are not archived will be contained and stored in drums pending profiling and disposal as described below.
 - 7.2.3 **Disposable Gloves and PPE** - Disposable PPE including gloves will be double bagged and disposed along with trash at a municipal landfill. Gloves that are grossly impacted by soils will be decontaminated prior to disposal.
 - 7.2.4 **Decontamination Rinsate Generated at Residential Properties** - Rinsate generated at individual properties from equipment or personnel decontamination will be disposed on the property at which the equipment was used, prior to leaving that property.
 - 7.2.5 **Decontamination Rinsate Generated at Field Office/Laboratory** - Rinsate generated at the field office/laboratory from equipment or personnel decontamination will be contained and stored in drums pending profiling and disposal as described below.
 - 7.2.6 **Trash** - All trash generated during the project will be contained in plastic trash bags for pick-up and disposal by a municipal trash management company; unauthorized disposal of trash in trash recepticals that service City of Denver residents and businesses will not be permitted.
- 7.3 Contained Waste**
- 7.3.1 **Containers** - Soils and decontamination rinsate waste generated at the field office/laboratory will be contained in DOT-compliant drums in accordance with 40 CFR 265 Part I. Trash and PPE contained outdoors will be placed in a closed plastic trash receptical to prevent disturbance by animals and dispersion by wind.



TECHNICAL STANDARD OPERATING PROCEDURE INVESTIGATION DERIVED WASTE MANAGEMENT

- 7.3.2 **Labeling** - All drummed IDW will be labeled as to its contents, source of material and the date on which waste accumulation begins. Non-hazardous waste labels will be used if appropriate. Additional labeling requirements specified in 40 CFR 262 and 265 Subpart I will be performed for waste that it determined to meet the criteria of a RCRA Hazardous Waste.
- 7.3.3 **Storage** - All drummed IDW will be stored in a designated area and in a manner that minimizes the potential for container damage or personnel injury. Non-hazardous waste will be segregated from waste that is determined to meet the criteria of a RCRA Hazardous Waste. As a protective measure, hazardous waste will be stored in a secure (fenced), lined, bermed area, and will be subject to weekly inspections in accordance with 40 CFR 262. Water accumulating in the lined storage area after a precipitation event will be removed and contained with the non-hazardous rinsate waste.
- 7.3.4 **Profiling** - All drummed IDW will be profiled using knowledge of the material and/or analytical data. Profile forms will be completed and submitted to the appropriate disposal facility as the basis of waste acceptance.
- 7.3.5 **Transportation and Disposal** - Drummed IDW will be transported and disposed by transporters and facilities permitted to manage the profiled waste. All non-hazardous waste will be managed as industrial or special waste, and shipped under a non-hazardous waste bill of lading. Hazardous waste will be shipped to an EPA-approved RCRA Subtitle C facility under a RCRA Uniform Hazardous Waste Manifest, identified with the EPA Generator ID, and in accordance with all DOT requirements for shipping hazardous materials. A DOT Hazardous Material Registration must be provided by the transporter and accompany each hazardous material shipment. Disposal certification will be obtained from the RCRA Subtitle C facility.

7.4 IDW Log

A waste log will be developed and maintained to document the following information:

- Description of waste generated (e.g. soils, water)



TECHNICAL STANDARD OPERATING PROCEDURE INVESTIGATION DERIVED WASTE MANAGEMENT

- Classification of wastes (non-hazardous, hazardous, etc.) including EPA code as applicable
- Quantities of waste generated
- Type of waste storage container
- Dates of waste generation
- Manifest/Bill of Lading Numbers

8.0 RECORDS


- Waste Log
- Waste Profiles
- Non-Hazardous Waste Manifest/Bill of Lading
- RCRA Uniform Hazardous Waste Manifest, if needed
- Hazardous Waste Disposal Certification, if needed
- DOT Hazardous Material Registration, if needed



Shaw SOPs

Shaw Procedures

EID-FS001	Field Logbook
EID-FS002	Field Logsheet
EID-FS005	Custody Seals
EID-FS006	Sample Labeling
EID-FS102	Surface Soil Sampling Using a Bulb Planter
EID-FS011	Composites
EID-FS020	Data Usability Review
EID-FS012	Shipping and Packaging of Non-Hazardous Samples
PRI	Soil Sampling
PRI	Fill Materials

	Document Type: <h1>Discipline-Specific Procedure</h1>	Level: 3 Owner: Applied Science & Engineering Origination Date: 6/5/2003 Revision Date: 8/25/2011
Group: E&I	Title: Field Logbook	No: EID-FS-001 Revision No.: 2 Page 1 of 5

Uncontrolled when printed: Verify latest version on ShawNet/Governance

1. PURPOSE

This procedure is intended to communicate the requirements for selection, use, and maintenance of all field logbooks. Field logbooks are often used to document observations, sampling information, and other pertinent information on project sites. They are considered legal documents and should be maintained and documented accordingly as part of the project file.

2. SCOPE

This procedure is applicable to all Shaw E & I site operations where field logbooks are utilized to document all site activities and pertinent information.

3. REFERENCES

- Nielsen Environmental Field School, 1997, *Field Notebook Guidelines*

4. DEFINITIONS

- **Significant detail**—Any piece and/or pieces of information or an observation that can be considered pertinent to the legal reconstruction of events, description of conditions, or documentation of samples and/or sampling procedures.
- **Significant event**—Any event or events that could influence or be considered pertinent to a specific task or function and therefore require documentation in the Field Logbook.
- **Field Logbook**—Logbooks used at field sites that contain detailed information regarding site activities that must include dates, times, personnel names, activities conducted, equipment used, weather conditions, etc. Field logbooks can be used by a variety of different field personnel and are part of the project file.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

Group: E&I	Title: Field Logbook	No: EID-FS-001 Revision No.: 2 Page 2 of 5
--------------------------	--------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

6. PROCEDURE

6.1 General

Each site or operation, as applicable, will have one current Logbook, which will serve as an index of all activities performed at the site or in the task performance. The Logbook is initiated at the start of the first applicable activity. Summary entries are made for every day that covered activities take place. Multiple field logbooks may be used depending upon the number of different types of field personnel conducting work and the various activities at the site. These field logbooks and the site logbooks shall be made part of the project files.

Information recorded in field logbooks includes observations (significant events and details), data, calculations, time, weather, and descriptions of the data collection activity, methods, instruments, and results. Additionally, the field logbook may contain descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

6.2 Equipment and Materials

- Logbook(s), bound with numbered pages, hard-covered, waterproof preferred. One per project or separate significant task (example-treatment residual composite collection).
- Indelible black or dark blue ink pen
- Other items needed to perform required tasks: compass, ruler, calculator, etc.

6.3 Preparation

Site personnel responsible for maintaining field logbooks must be familiar with the SOPs for all tasks to be performed.

Field logbooks are project files and should remain with project documentation when not in use. *Personnel should not keep Field logbooks in their possession when not in use. Field logbooks should only leave the project site for limited periods, and they should always be returned to the site files or the designated on-site location (Sampler's Trailer, etc.).*

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the field logbook.

The front cover shall include the following information:

- Project Number
- Project Name and Task(s) included in logbook
- Dates covered by logbook—the starting date must be entered on the first day of use
- Logbook number—if more than one logbook will be needed to cover project/task(s)

The inside front cover shall contain a listing and sign-off of each person authorized to make entries and/or review the logbook. All persons who make entries or review/approve such entries must signify their authority to enter into the logbook via their signature and the date of their signing on the inside front cover. If initials are used for entries instead of full names, the initials must be entered beside the full name on the inside cover.

6.4 Operation

The following requirements must be met when using a field logbook:

- Record significant details and/or events, work, observations, material quantities, calculations, drawings, and related information directly in the field logbook. If data-collection forms are in

Group: E&I	Title: Field Logbook	No: EID-FS-001 Revision No.: 2 Page 3 of 5
--------------------------	--------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

use, the information on the form need not be duplicated in the field logbook. However, any forms used to record site information *must be referenced* in the field logbook.

- Information must be factual and unbiased.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Write in black or dark blue indelible ink.
- Do not erase, scribble over, or blot out any entry. Do not use White-Out or like correction items. Before an entry has been signed and dated, changes may be made; however, care must be taken not to obliterate what was written originally. Indicate any deletion by a single line through the material to be deleted. Any change shall be initialed and dated. Error codes (Attachment 1) should be added to the end of the deleted entry. All error codes should be circled.
- Do not remove any pages from the book.
- Do not use loose paper and copy into the field logbook later.
- Record sufficient information to completely document field activities and all significant details/events applicable to the project/task(s) covered by the logbook.
- All entries should be neat and legible.

Specific requirements for field logbook entries include the following:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial, date, and if used, code all changes properly.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:
 - a) Date and time
 - b) Name of individual making entry
 - c) Detailed description of activity being conducted including well, boring, sampling, location number as appropriate
 - d) Unusual site conditions
 - e) Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction and speed) and other pertinent data
 - f) Sample pickup (chain-of-custody form numbers, carrier, time)
 - g) Sampling activities/sample log sheet numbers
 - h) Start and completion of borehole/trench/monitoring well installation or sampling activity
 - i) Health and Safety issues, such as PPE upgrades, monitoring results, near-misses, and incidents associated with the logbook areas
 - j) Instrumentation calibration details

Group: E&I	Title: Field Logbook	No: EID-FS-001 Revision No.: 2 Page 4 of 5
--------------------------	--------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

Entries into the field logbook shall be preceded with the time of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In such cases, the field logbook must reference the automatic data record or form.

While sampling, make sure to record observations such as color and odor. Indicate the locations from which samples are being taken, sample identification numbers, the order of filling bottles, sample volumes, and parameters to be analyzed. If field duplicate samples are being collected, note the duplicate pair sample identification numbers. If samples are collected that will be used for matrix spike and/or matrix spike/matrix spike duplicate analysis, record that information in the field logbook.

A sketch of the station location may be warranted. All maps or sketches made in the field logbook should have descriptions of the features shown and a direction indicator. There must be at least one fixed point with measurements on any map drawn. Maps and sketches should be oriented so that north is towards the top of the page.

Other events and observations that should be recorded include (but are not limited to) the following:

- Changes in weather that impact field activities
- Visitors to the site associated with the covered task(s). Note their time of arrival and departure and provide a brief summary of their purpose on site.
- Subcontractor activities applicable to the covered task(s)
- Deviations from procedures outlined in any governing documents, including the reason for the deviation. Deviations from procedures must be accompanied with the proper authorization.
- Significant events that may influence data, such as vehicles in the vicinity of VOC sampling efforts
- Problems, downtime, or delays
- Upgrade or downgrade of personal protective equipment

6.5 Post-Operation

To guard against loss of data due to damage or disappearance of field logbooks, all original completed logbooks shall be securely stored by the project. All field logbooks will be copied at the end of each work shift and attached to the daily reports.

At the conclusion of each activity or phase of site work, the individual responsible for the field logbook will ensure that all entries have been appropriately signed and dated and that corrections were made properly (single lines drawn through incorrect information, initialed, coded, and dated). The completed field logbook shall be submitted to the project records file.

6.6 Restrictions/Limitations

Field logbooks constitute the official record of on-site technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by Shaw personnel and their subcontractors. They are documents that may be used in court to indicate and defend dates, personnel, procedures, and techniques employed during site activities. Entries made in these notebooks should be factual,

Group: E&I	Title: Field Logbook	No: EID-FS-001 Revision No.: 2 Page 5 of 5
--------------------------	--------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

clear, precise, and as non-subjective as possible. Field logbooks, and entries within, are not to be utilized for personal use.

7. ATTACHMENTS

- Attachment 1, Common Data Error Codes

8. FORMS

None

9. RECORDS

- Field Logbook

10. REVISION HISTORY AND APPROVAL

Revision Level	Revision Description	Responsible Manager
Revision Date		
00	Initial Issue	N/A
6/5/2003		
01	New template, new numbering of procedure, Section 1 Purpose- content added, Section 2 edited, Section 4-Definitions edited. Sections 6.2, 6.3, 6.4, 6.5 and 6.6 were all edited.	Guy Gallelo
9/8/2006		
02	Modified format only to align with Governance Management framework	Scott Logan
8/25/2011		


Uncontrolled when printed: Verify latest version on ShawNet/Governance

**Attachment 1
Common Data Error Codes**

COMMON DATA ERROR CODES

- RE Recording Error
- CE Calculation Error
- TE Transcription Error
- SE Spelling Error
- CL Changed for Clarity
- DC Original Sample Description Changed After Further Evaluation
- WO Write Over
- NI Not Initialed and Dated at Time of Entry
- OB Not Recorded at the Time of Initial Observation

All Error Codes should be circled.

	Document Type: <h1>Discipline-Specific Procedure</h1>	Level: 3 Owner: Applied Science & Engineering Origination Date: 6/5/2003 Revision Date: 1/23/2012
Group: E&I	Title: Field Logsheet	No: EID-FS-002 Revision No.: 2 Page 1 of 3

Uncontrolled when printed: Verify latest version on ShawNet/Governance

1. PURPOSE

This procedure is intended to communicate the requirements for proper use and completion of Field Logsheets to document sample collection and data gathering activities. Field Logsheets are often utilized to document single location/event information. Examples include boring logs and drum/container logs. This procedure also provides several templates that *may* be utilized or modified to a particular need.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where Field Logsheets are utilized to document data and/or sample collection information. This procedure does **not** mandate the use of Field Logsheets on all Shaw E & I data/sample collection efforts, and projects/programs are free to utilize other means (Field Logbooks, direct data entry, etc.) to document sample collection and other pertinent data gathering activities.

3. REFERENCES

- U.S. Environmental Protection Agency, 1998, *EPA Guidance for Quality Assurance Project Plans*, EPA/600/R-98/018, Washington, D.C.
- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, EM200-1-3, Washington, D.C.

4. DEFINITIONS

None

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

Group: E&I	Title: Field Logsheet	No: EID-FS-002 Revision No.: 2 Page 2 of 3
--------------------------	---------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

6. PROCEDURE

Field Logsheets can be prepared to address the specific needs of each project and they can even be converted to laptop data entry forms. Field Logsheets are considered legally defensible, and all appropriate requirements must be observed.

6.1 Required Information

All Field Logsheets must contain entry lines for the following in addition to whatever sample/data gathering-specific information is desired:

- Site/Project Name
- Project Number
- Date (including time if required to properly document)
- Comments or Issues are a t o r e c o r d any non-specified information pertinent t o the sample/data collection effort
- Initial or signature line for person responsible for completion

6.2 Proper Completion/Use

Whenever Field Logsheets are utilized, the following requirements must be strictly followed and enforced:

- Field Logsheets are to be completed in **real-time**. They should not be filled out by transcription from another source.
- All corrections **must** be single-line cross-out with the initials of the person making the correction.
- All data/information areas **must** be completed. If an entry line/block is not applicable to a particular sample/data gathering effort, this must be indicated on the form by either a single line cross-out or the letters "NA" being written in the data line/block.

7. ATTACHMENTS

None

8. FORMS

- EID-FS-002.01, Waste Container Field Logsheet
- EID-FS-002.02, Soil/Sediment Field Logsheet
- EID-FS-002.03, Surface Water Field Logsheet
- EID-FS-002.04, Air Field Logsheet

9. RECORDS

- Field Logsheet

Group: E&I	Title: Field Logsheet	No: EID-FS-002 Revision No.: 2 Page 3 of 3
--------------------------	---------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

10. REVISION HISTORY AND APPROVAL

Revision Level	Revision Description	Responsible Manager
Revision Date		
00	Initial issue	Guy Gallelo
6/5/2003		
01	Revised Section1 Purpose and Section 2 Scope. Revised section 6.1 Site Information. Changed Section 6.2 Sample Information, 6.3 Equipment Information, 6.4 Analytical to Section 6.2 being Proper Completion/Use.	Guy Gallelo
9/8/2006		
02	Modified format only to align with Governance Management framework.	Scott Logan
1/23/2012		



Title:
Field Logsheet

Form No: EID-FS-002.01_2

Uncontrolled when printed: Verify latest version on ShawNet/Governance

Waste Container Field Logsheet

Date: _____ Time: _____

Site: _____

Container Number: _____

Project #: _____

Container Size: _____

Weather: _____

Container Location: _____

Photograph: _____

Container material of construction: plastic glass metal fiberboard

Container condition: intact bulging leaking

Lid type: screw bung ring

Lid material of construction: plastic glass metal fiberboard

Labels: manufacturer: _____
address: _____
content name: _____
chemical name: _____
chemical formula: _____
other: _____

Hazard flammability: _____
Label: reactivity: _____
health: _____
other: _____

PID: _____ Calibration Date: _____

O2/LEL: _____ Calibration Date: _____

Sampling Device: _____ Decontamination technique: _____

Contents Description:
Amount: 1/4 1/2 3/4 full
Color: _____
State: solid liquid paste other: _____

Sample Number: _____ Preservative: _____

QC Samples: _____

Analyses requested: _____

Analytical Laboratory: _____

Field Technician (Print): _____

Comments: _____



Title:
Field Logsheet

Form No: EID-FS-002.02_2

Uncontrolled when printed: Verify latest version on ShawNet/Governance

Soil / Sediment Field Logsheet

Site Name:

Project #:

Sample ID:	Sample Location Sketch:
Sample Type*:	
*: SED=Sediment; SUR=Surface soil; SUB=Subsurface Soil; OTH=Other.	
grab=Grab, comp=Composite	
Date Sampled:	
Time Sampled:	
Depth (ft bgs):	
Physical description:	
Analyses requested:	
	Photograph Log #:
PID:	Calibration Date:
O2/LEL:	Calibration Date:
Weather:	
Temperature: ° F	
Sampling Equipment:	
Equipment Decontamination Technique:	
QC Samples:	
Analytical Laboratory:	
Comments:	
Field Technician: (Print)	Date:



Title:

Field Logsheet

Form No: EID-FS-002.03_2

Uncontrolled when printed: Verify latest version on ShawNet/Governance

Surface Water Field Logsheet

Site Name:

Project #:

Sample ID:		Sample Location Sketch:
Date Sampled:		
Time Sampled:		
Depth (ft below surface):		
Analysis	Preservative	
Field Reading	Calibration Date	
Sp cond:		
pH:		Photograph Log #:
Temp:		Weather:
D.O.:		Temperature: ° F
Turbidity:		Sampling Equipment:
		Equipment Decon Technique:
QC Samples:		
Analytical Laboratory:		
Comments:		
Field Technician: (Print)		Date:



Title:

Field Logsheet

Form No: EID-FS-002.04_2


Uncontrolled when printed: Verify latest version on ShawNet/Governance

Air Field Logsheet

Site Name:

Project #:

Sample ID:		Sample Location Sketch:
Date Sampled:		
Time Sampled:		
Sampling Technique:		
Analyses:		
Field Reading	Calibration Date	
		Photograph Log #:
Weather:		
Temperature: ° F		
Sampling Equipment:		
Equipment Decon Technique:		
QC Samples:		
Analytical Laboratory:		
Comments:		
Field Technician: (Print)		Date:

	Document Type: <h1>Discipline-Specific Procedure</h1>	Level: 3 Owner: Applied Science & Engineering Origination Date: 8/14/2003 Revision Date: 8/25/2011
Group: E&I	Title: Custody Seals	No: EID-FS-005 Revision No.: 2 Page 1 of 3

Uncontrolled when printed: Verify latest version on ShawNet/Governance

1. PURPOSE

The purpose of this procedure is to provide the requirements for completion and attachment of Custody Seals on environmental samples and shipping containers.

2. SCOPE

This procedure is applicable to all Shaw E & I efforts where sample legal defensibility and custody integrity is desired. Adherence to this procedure is not required whenever the same individual/team is performing the sampling and testing within the same workday, and transfer to the testing process is being documented by other means, i.e. sampling and then field-screening in a mobile laboratory.

3. REFERENCES

- U.S. Environmental Protection Agency, 1986, *Test Methods for Evaluating Solid Waste; Physical/Chemical Methods, SW-846*, Third Edition.
- U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plans, EM200-1-3*
- Shaw E & I, 2002, Sampler's Training Course Handout.

4. DEFINITIONS

- **Custody**—The legal term used to define the control and evidence traceability of an environmental sample. A sample is considered to be in one's custody if it is in actual physical possession of the person, is in view of the person, has been locked in a container controlled by the person, or has been placed into a designated secure area by the person.
- **Custody Seal**—Commercially available thin strips of adhesive paper with write-in lines for the date/time and identification of the using party. Custody seals are placed over the caps of sample containers and along the cover seals of shipping containers as a means to detect tampering before arrival at the testing facility. All Shaw E & I strategic alliance laboratories provide Custody Seals in their sample container supply kits.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw E & I employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw E & I employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting

Group: E&I	Title: Custody Seals	No: EID-FS-005 Revision No.: 2 Page 2 of 3
--------------------------	--------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Completing the Custody Seal Information

- All Custody Seals must be completed in indelible ink. All corrections must be made using standard single-line cross-out methods, and the initials of the individual making the change must be included beside the corrected entry.
- Each Custody Seal attached must be completed by writing the *Date*, at a minimum, and signing with *full signature* by the person responsible for the sealing of the sample.
- If a space is provided, the *Time* should also be added.

6.2 Attaching the Custody Seals

Whenever possible, custody seals should be attached over the sample container lids during actual sampling and not when the samples are packaged for shipment. This will provide confidence in legal custody and will demonstrate non-tampering during the sample collection process.

Do not attach custody seals to VOC sample containers, as contamination may occur. For these samples, the custody seal should be used to seal the folded plastic zip bag that holds the sample containers.

- For sample jars, the completed Custody Seal should be placed across the top of the lid with the edges below the lid/jar interface and attached to the jar material. This will require the visible breaking of the seal in order to open the container.
- Sample coolers and shipping containers should have Custody Seals attached in such a manner that the seal extends lengthwise from the top edge of the lid to the side of the cooler/container.

7. ATTACHMENTS

None

8. FORMS

None

9. RECORDS

None


10. REVISION HISTORY AND APPROVAL

Revision Level	Revision Description	Responsible Manager
Revision Date		
00	Initial Issue	N/A
08/14/2003		
01	New template, new numbering of procedure, no content changes	Guy Gallelo
09/08/2006		

Group: E&I	Title: Custody Seals	No: EID-FS-005 Revision No.: 2 Page 3 of 3
--------------------------	--------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

Revision Level	Revision Description	Responsible Manager
Revision Date		
02	Modified format only to align with Governance Management framework	Scott Logan
08/25/2011		

	Document Type: <h1>Discipline-Specific Procedure</h1>	Level: 3 Owner: Applied Science & Engineering Origination Date: 8/17/2003 Revision Date: 8/25/2011
Group: E&I	Title: Sample Labeling	No: EID-FS-006 Revision No.: 2 Page 1 of 2

Uncontrolled when printed: Verify latest version on ShawNet/Governance

1. PURPOSE

The purpose of this procedure is to provide the requirements for completion and attachment of sample labels on environmental sample containers.

2. SCOPE

This procedure is applicable to all Shaw E & I projects/proposals where samples will be collected.

3. REFERENCES

- U.S. Environmental Protection Agency, 1986, *Test Methods for Evaluating Solid Waste; Physical/Chemical Methods*, SW-846, Third Edition.
- U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plans*, EM200-1-3
- Shaw E & I, 2002, Sampler's Training Course Handout.

4. DEFINITIONS

- **Sample Label**—Any writing surface with an adhesive backing that can be used to document sample identification information. The sample label is attached to the sample container as a means of identification and, in some commercially available or laboratory-supplied containers, may be pre-attached. All Shaw E & I strategic alliance laboratories provide sample labels or pre-labeled containers in their sample container supply kits.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw E & I employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw E & I employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

- All sample labels must be completed in indelible ink. All corrections must be performed using standard single-line cross-out methods, and the initials of the individual making the change must be included beside the corrected entry.

Group: E&I	Title: Sample Labeling	No: EID-FS-006 Revision No.: 2 Page 2 of 2
--------------------------	----------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

- Sample labels should be completed and attached as samples are collected. Do not wait until final packaging to attach and/or complete the sample labels.
- Sample labels must be attached to the non-sealing portion of the container. Do not place labels on or across sample container caps.
- If the laboratory has provided pre-labeled containers, make sure to fill one for each parameter set needed. Laboratory pre-labeled containers are often bar-coded and it is important to provide a complete container set for each sample.
- The following information must be recorded on the Sample Label:
 - Sample Identification Number
 - Date and Time collected
 - Initials of person(s) responsible for collection
- If a space is provided, the *Analysis Requested* should also be added.
- If a *Description* is provided, remember it must match that on the Chain of Custody form for cross-referencing purposes.
- Cover the completed and attached label with clear plastic tape to prevent bleeding of the ink if it becomes wetted. *Do **not** perform this step for pre-weighed VOC vials, as the final weight values will be influenced by the mass of the tape. Protect these containers by enclosing the rack/holder in a plastic bag within the cooler.*

7. ATTACHMENTS

None

8. FORMS


None

9. RECORDS

None

10. REVISION HISTORY AND APPROVAL

Revision Level	Revision Description	Responsible Manager
Revision Date		
00	Initial issue	N/A
09/08/2006		
01	Updated template, procedure numbering change, updated Section 2- Scope, Edited content in section 6.	Guy Gallelo
09/08/2006		
02	Modified format only to align with Governance Management framework	Scott Logan
08/28/2011		

	Document Type: <h1>Discipline-Specific Procedure</h1>	Level: 3 Owner: Applied Science & Engineering Origination Date: 12/05/2003 Revision Date: 8/25/2011
Group: E&I	Title: Bulb Planter Surface Soil Sampling	No: EID-FS-102 Revision No.: 2 Page 1 of 3

Uncontrolled when printed: Verify latest version on ShawNet/Governance

1. PURPOSE

The purpose of this document is to provide the methods and procedure for sampling of surface (0 to 12") soils using a bulb planter. Bulb planters can be used when matrices are composed of relatively soft and non-cemented formations to collect surface soils or to access deeper soils down to 18-inches into the ground surface, dependent on site conditions. This is an effective sampling device to perform depth-sampling where the depth is the critical factor, such as when sampling soil from in-situ treatment of the top 8 inches. Samples for Volatile Organic Compound (VOC) analysis should not be collected via bulb planter method. However, a bulb planter may be utilized to penetrate to and expose the undisturbed material at the desired depth for sampling by more applicable methods.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where surface soil samples will be collected via bulb planter methods.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, Appendix C, Section C.6, EM200-1-3, Washington, D.C.

4. DEFINITIONS

- **Bulb Planter**—A sample collection device with a small bucket attached to a handle. It is typically used in gardening to plant flower bulbs. All trace environmental samples should be collected using stainless steel sampling devices.
- **Surface Soil**—Soil that is removed from the surface no greater than 18 inches below grade after removing vegetation, rocks, twigs, etc. Several states and regulators define surface soils differently (0-6", 0-12", 0-3") depending upon the intended data use.
- **Weathered Soil**—The top 1/8 to 1/4 inch of soil impacted by heat from sun, rain, or foot traffic that could evaporate, dilute, or otherwise deposit contaminants from an adjacent location, thereby misrepresenting the actual soil characteristic.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for the maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting

Group: E&I	Title: Bulb Planter Surface Soil Sampling	No: EID-FS-102 Revision No.: 2 Page 2 of 3
--------------------------	---	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Equipment

- Decontaminated bulb planter, stainless steel construction for trace environmental sampling. If samples will be collected at depth (0 to 18 inches), the bulb planter will require decontamination prior to collection of the targeted-depth sample. Alternatively, a different bulb planter can be used to remove the material to the targeted depth and the sample collected using a clean dedicated bulb planter or other sampling device.
- Engineers rule or stiff measuring tape
- Decontaminated stainless steel mixing bowl

6.2 Sampling

The sampling procedure is as follows:

1. Don a pair of clean gloves.
2. If desired, place plastic sheeting around the targeted location to keep sampled material in place. Use a knife to cut an access hole for the sample location.
3. Remove any surficial debris (e.g. vegetation, rocks, twigs) from the sample location and surrounding area until the soil is exposed. Once exposed, the soil surface is designated as "at grade," or 0 inches.
4. Use a clean trowel or other clean tool to scrape and remove the top $\frac{1}{8}$ to $\frac{1}{4}$ inch of weathered soil.
5. With a new or decontaminated bulb planter, place the receiving end of the bucket flush with the soil. Using a twisting motion, push downward on the bulb planter until the bucket is inserted to the required depth or the bucket is nearly covered.
6. Ensure that the bulb planter is not inserted to a depth where the soil will touch the handle, other non-stainless steel portion of the bulb planter, or the sampler's hand.
7. With a side-to-side motion, lift up the bulb planter with soil in the bucket and place the soil either into the sample mixing bowl or aside onto the plastic sheeting.
8. Measure the depth of the hole and either record it (if the sample was collected) or continue to the desired depth.
9. Repeat steps 5 through 8, if necessary, until the required depth of soil is achieved. If sampling at a depth beyond the length of the bulb planter, use a new or freshly decontaminated bulb planter to collect the actual sample (steps 5 through 7) once the top of the desired depth range is achieved. If collecting a sample for volatile parameters, perform this first using an applicable method
10. Measure the depth of the sample location with a rule or tape to verify the sampling depth and record it in the field logbook.
11. Mix and containerize the non-volatile sample aliquots, complete all required documentation, and prepare the sample for shipment.

Group: E&I	Title: Bulb Planter Surface Soil Sampling	No: EID-FS-102 Revision No.: 2 Page 3 of 3
--------------------------	---	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

7. ATTACHMENTS

None

8. FORMS


None

9. RECORDS

- Measurements recorded in Field Logbook or Field Logsheet

10. REVISION HISTORY AND APPROVAL

Revision Level	Revision Description	Responsible Manager
Revision Date		
00	Initial issue	N/A
12/05/2003		
01	Updated template and numbering of procedure, minor edits to Section 1- Purpose, updated content in Section 6.2- Sampling.	Guy Gallelo
09/11/2006		
02	Modified format only to align with Governance Management framework	Scott Logan
08/25/2011		

	Document Type: <h1>Discipline-Specific Procedure</h1>	Level: 3 Owner: Applied Science & Engineering Origination Date: 8/14/2003 Revision Date: 8/25/2011
Group: E&I	Title: Compositing	No: EID-FS-011 Revision No.: 2 Page 1 of 3

Uncontrolled when printed: Verify latest version on ShawNet/Governance

1. PURPOSE

This procedure is intended to provide guidelines for the compositing of samples collected in the course of environmental program activities. Composites represent the average distribution of properties and can be used to reduce analytical costs or represent well-defined decision boundaries.

2. SCOPE

This procedure applies to the compositing of solid and liquid samples where no project-specific process is in place. Field composite methods are not appropriate for Volatile Organic Compounds (VOC) analysis of solids. Composites for these methods must be laboratory derived using either individual grab extracts or other laboratory methods.

3. REFERENCES

- U.S. Environmental Protection Agency, 1987, *Compendium of Superfund Field Operations Methods*, EPA 540/P-87/001a, OSWER 9355.0-14, Washington, DC.
- Shaw E & I Standard Operating Procedure EID-FS-010, *Sample Mixing/Homogenization*.

4. DEFINITIONS

- **Composite Sample**—A sample that is comprised of roughly equal amounts of discrete grabs from a set of sample locations or time/flow increments known as a *sample group*.
- **Sample Group**—A predetermined number or time/area span of discrete samples, which is composited into one sample for analytical purposes.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be sent to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw E & I employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw E & I employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager or designee is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

Group: E&I	Title: Compositing	No: EID-FS-011 Revision No.: 2 Page 2 of 3
--------------------------	------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

6. PROCEDURE

The discrete samples that are used to prepare a composite sample must be of equal volume and must each be collected in an identical manner. Field documentation must clearly indicate the composite elements on either a map or a composite logsheet. There are several types of composite samples.

Flow-proportioned composite—Flow-proportioned composite samples are collected proportional to the flow rate during the sampling period by either a time-varying/constant-volume or time-constant/varying-volume method. Flow-proportioned composite samples are typically collected using automatic samplers paced by a flow meter. This sampling method is commonly used for wastewaters.

Time composite—A time composite sample is composed of a discrete number of grab samples collected at equal time intervals during the sampling period. Time composite sampling is often used to sample wastewater discharges or streams.

Volume/mass composite—A volume/mass composite is composed of a discrete number of grab samples collected at defined volume or mass intervals. Volume/mass composite sampling is often used to sample the output of a process system such as a Thermal Destruction Unit or pug mill.

Area composite—Area composite samples are samples collected from individual grab samples located on a regularly spaced grid or along a pile at defined locations and depths. Each of the grab samples must be collected in an identical fashion and must be of equal volume.

Vertical or Depth composite—Vertical composites are composed of individual grab samples collected across a vertical cross section. Like area composites, the grab samples must be collected in an identical fashion and must be of equal volume. Soils and sediments can be used to create vertical composites.

6.1 Solid Composites

- To ensure the integrity of the composite, all discrete grab samples must be collected in an identical manner.
- Composite samples can be created by combining discrete grab samples into the same mixing/holding container as they are collected or by combining and mixing equal aliquots of containerized and homogenized discrete grab samples.
- Remove coarse fragments and organic material from the mixing bowl. Homogenize the sample as specified in SOP FS010, Sample Mixing/Homogenization.
- Remove sample aliquots and place into the appropriate sample containers for shipment to the laboratory.
- Label the sample and document the sampling event according to the project procedures.
- Package/ship the composite sample as required.

6.2 Liquid Composites

- Liquid composite samples should be created by combining equal aliquots of discrete samples.
- Assemble the containers that will comprise a given composite.
- Swirl or stir the individual containers to homogenize the contents just prior to removing the measured aliquots.

Group: E&I	Title: Compositing	No: EID-FS-011 Revision No.: 2 Page 3 of 3
--------------------------	------------------------------	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

- Using clean glass pipets, deliver equal volumes from each grab container to the composite sample container that is to be shipped to the lab. For example, if there are five grab samples, and the composite sample requires 100 mL for the parameter of interest, pipet 20 mL from each of the grab samples into the composite sample container.
- Alternatively, measured volumes can be determined via a graduated cylinder/beaker and combined. The measuring container should be decontaminated between composites.
- Cap/seal the composite container and swirl to agitate. Stirring should be avoided as it increases the risk of introducing contamination to the sample.
- Label the sample(s), document the event, and package/ship the sample(s) as required.

7. ATTACHMENTS

None

8. FORMS

None

9. RECORDS

None

10. REVISION HISTORY AND APPROVAL

Revision Level	Revision Description	Responsible Manager
Revision Date		
00	Initial Issue	N/A
08/14/2003		
01	Updated template and numbering of procedure changed, updated Section 2-Scope, added content to 6.1 and 6.2.	Guy Gallelo
09/08/2006		
02	Modified format only to align with Governance Management framework.	Scott Logan
08/25/2011		

	Document Type: <h1>Discipline-Specific Procedure</h1>	Level: 3 Owner: Applied Science & Engineering Origination Date: 6/5/2003 Revision Date: 8/25/2011
Group: E&I	Title: Data Usability Review	No: EID-FS-020 Revision No.: 2 Page 1 of 5

Uncontrolled when printed: Verify latest version on ShawNet/Governance

1. PURPOSE

The purpose of this procedure is to establish the means by which all subcontracted environmental analytical data will be reviewed for completeness and usability based upon comparison to the project action/decision levels and Data Quality Objectives before use in the intended decision-making processes.

2. SCOPE

This procedure applies to all subcontracted analytical data including faxed or e-mailed preliminary reports.

By way of its requirements, this procedure prohibits verbal communication of analytical results and establishes minimum deliverable standards that must be provided for all subcontracted analytical data reports—including faxed or e-mailed preliminary reports. These minimum standards include the following:

- Sample Results
- Chain of Custody – unless already available to the reviewer
- Sample Receipt Documentation – unless already available to the reviewer
- QC Summary – Laboratory Control Blank, Laboratory Control Spike, Matrix Spike, Matrix Spike Duplicate, Post-digest Spike
- Surrogate Summary – (if applicable)
- Hold-time Compliance Summary – or signed certification that all requirements were met
- Initial and Continuing Calibration Information – or signed certification that it meets prescribed requirements
- GC/MS Tuning Information – (if applicable) or signed certification that it meets prescribed requirements

This procedure should be performed only by or under the oversight of properly qualified individuals. Oversight may be accomplished through provision of a project-specific and well-defined checklist, training in its use, regular QA checks, and real-time availability for issue resolution.

3. REFERENCES

- U.S. Environmental Protection Agency, *National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94-013.
- U.S. Environmental Protection Agency, *National Functional Guidelines for Organic Data Review*, EPA 540/R-94-012.
- U.S. Department of Defense, 2002, Department of Defense Quality Systems Manual for Environmental Laboratories, Final, June.
- U.S. Army Corps of Engineers, Requirements for the Preparation of Sampling and Analysis Plans, EM-200-1-3.

Group: E&I	Title: Data Usability Review	No: EID-FS-020 Revision No.: 2 Page 2 of 5
--------------------------	--	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

4. DEFINITIONS

- **Data Usability Review (DUR)**—The cursory review of an analytical data package for completeness and compliance with the ordered analysis, specified quality, and method/project-specific protocols before the data is used as input to a particular project decision-making process. The DUR process identifies any potential data quality issues and informs the data users of the effect on the data usability.
- **Data Quality Objectives**—The empirical statements and quantitative measures necessary for a given set of measurements to be usable in the planned decision.
- **Data Quality Indicators**—Field and laboratory measures for which compliance with specified requirements or limits can be construed to support attainment of the Data Quality Objectives in a given data set.
- **Analytical Data Package**—The manner in which analytical results are provided from subcontractor laboratories. Analytical Data Packages can be received via fax, e-mail, or postal mail.
- **QC Summary**—A summary table of laboratory QC sample results.
- **Laboratory Control Blank (LCB)**—Reagent Water or Clean Solid Matrix analyzed in the same manner as a sample to determine the Target Analyte concentration contribution due to contamination in the entire analytical system.
- **Laboratory Control Spike (LCS)**—Reagent Water or Clean Solid Matrix spiked with a known concentration of target analytes and analyzed as a sample to determine the method accuracy of the analytical system.
- **Matrix Spike**—A sample spiked with a known concentration of target analyte and analyzed along with the rest of the analytical batch. The percent recovery of the target analytes is used to determine the effect on accuracy due to the sample matrix.
- **Matrix Spike Duplicate**—A duplicate of the Matrix Spike used to determine the analytical precision, expressed as Relative Percent Difference (RPD) of the analytical system.
- **Surrogate Compound**—In several organic methods, a compound similar in structure and chemical behavior to the target analytes, which is added to each Sample and QC Sample at a known concentration before the analysis begins. The surrogate recovery is used to approximate the recovery of the target compounds based upon the behavior of chemically similar analytes.
- **Post-digest Spike**—In metals analyses, used to determine the possibility of chemical interferences and digestion deficiencies. If the normal QC results are unacceptable, a known concentration of the target analyte is added to the sample digestate. The recovery is then used to determine if reanalysis or data qualification is warranted.
- **QC Acceptance Range**—The limits that define QC results demonstrating compliant accuracy and precision.
- **Qualified Person**—An individual capable through knowledge, education, formal training, and/or experience in the establishment and verification of analytical Data Quality Objectives. The Qualified Person is usually a chemist or environmental professional with several years of environmental analytical experience.

Group: E&I	Title: Data Usability Review	No: EID-FS-020 Revision No.: 2 Page 3 of 5
--------------------------	--	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

- **Trip Blank**—In VOC analysis, a container of Reagent Grade Water that is included in the sample cooler and analyzed by the laboratory to determine if cross-contamination may have occurred in shipping.
- **Ambient or Field Blank**—Reagent Grade Water containerized during sample collection activities and analyzed at the laboratory. The results are used to determine if sample results may be biased by site environmental factors.
- **Equipment Blank**—Final rinseate collected during sample equipment decontamination and analyzed by the laboratory. The results indicate the effectiveness of the decontamination procedure.
- **Field Duplicate**—An additional sample aliquot or, in some cases, a collocated sample that is collected and analyzed. The results are compared with the original samples as an indication of the overall precision of the entire sampling and analytical process.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that the activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 First-Level Review of the Data Package

Verify that the package contains all of the required elements listed in Section 2. If any items are missing, contact the laboratory immediately and correct the situation.

Compare the reported results to the Chain of Custody request, and verify that all expected samples and analyses results were reported. If results are missing, contact the laboratory and correct the situation. If the “missing” data is not available yet, perform partial review of the data provided and hold the package for follow-up once the non-reported results are provided.

6.2 Second-Level Review

Consult the project Chemical Quality Plan (SAP, QAPP, etc.) for information concerning sample types and analysis requirements.

Compare the reported analytes, methods, and detection limits to those in the project plan for the specific analyses. Be sure to account for indicated and reasonable increased reporting limits due to dilutions or sample effects. Address any discrepancies with the laboratory directly.

Group: E&I	Title: Data Usability Review	No: EID-FS-020 Revision No.: 2 Page 4 of 5
--------------------------	--	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

Compare the results to project action-levels, and circle or otherwise mark all results above the limits.

6.3 QC Level Review

Consult the project Data Usability Review Checklists and/or the project Chemical Quality Plan and evaluate all provided QC results against project acceptance limits.

Mark or flag any results that are outside of the project limits and note on the applicable checklist (if using one).

Also evaluate any Field QC results such as Duplicates and Trip Blanks against requirements and note any issues.

6.4 Usability Review

If all QC results for all samples are within the acceptance ranges, complete the appropriate section of the checklist and then date and sign the completed checklist.

If all QC is acceptable and you are not using a checklist, you must indicate data usability directly on the data package itself or on a separate cover sheet. To do this, date and initial the QC Summary pages and write "QC acceptable data OK for use" on the cover sheet or QC Summary page.

If any QC is non-compliant, review its impact to use as project data by referencing the QC Results Impact Table attached to this SOP and consult with the Qualified Person to determine final acceptability. Note on the Data Report itself or checklist all discrepancies and the reasons for data acceptance, qualification, or rejection. If a Qualified Person has made the decision, this should also be noted.

If any of the data is determined to be unusable, immediately notify the Project Manager and project site personnel.

6.5 Reporting of Usability Review Results

Project personnel must be provided either a spreadsheet summary of the results with an attached, signed and dated Statement of Usability, or the complete Data Package with the project-specific Data Usability Review documentation. At **no time** are results to be communicated verbally.

7. ATTACHMENTS

- Attachment 1, Project QC Impact Table

8. FORMS

None

9. RECORDS

- Data Usability Results

10. REVISION HISTORY AND APPROVAL

Revision Level	Revision Description	Responsible Manager
Revision Date		
00	Initial issue.	N/A

Group: E&I	Title: Data Usability Review	No: EID-FS-020 Revision No.: 2 Page 5 of 5
--------------------------	--	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

Revision Level	Revision Description	Responsible Manager
Revision Date		
06/05/2003		
01	Updated template and numbering of procedure	Guy Gallelo
09/08/2006		
02	Modified format only to align with Governance Management framework	Scott Logan
08/25/2011		

Uncontrolled when printed: Verify latest version on ShawNet/Governance

**Attachment 1
Project QC Impact Table**

QC Data Discrepancy	Result Non-detect	Result >10% Below Action-level	Result Within 10% of or Above Action-level	Result Greater than 10% Above Action-level
DISPOSAL				
Trip Blank Contaminated	No effect	No effect	No effect	No effect
LCB Contaminated	No effect on data	No effect on data	No effect unless contamination is >10% of action-level → reject	No effect unless contamination is => the difference between result and action-level
LCS Low Recovery	If MS/MSD are acceptable or Surrogates are acceptable and the RL is at most 20% of action-level → Data accepted	If MS/MSD are acceptable or Surrogates are acceptable → Data accepted Otherwise, flag and qualify that results may in fact be greater than action-level	If MS/MSD are acceptable or Surrogates are acceptable and LCS is within 10% of acceptance limit and result is above action-level → Data accepted Otherwise, flag and qualify result as suspected to be above action-level	No effect on data
LCS High Recovery	No effect on data	No effect on data	If MS/MSD are acceptable or Surrogates are acceptable evaluate potential bias in QC and accept data	No effect on data
Matrix Spike Low %R	If MSD and LCS acceptable and Surrogates or Post-spike within range Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range Data is accepted with precision qualifier	No effect on data	No effect on data
Matrix Spike High %R	No effect on data	No effect on data	No effect on data	No effect on data
MS/MSD RPD High	No effect on data	No effect on data	No effect on data	No effect on data
Surrogate %R Low	If surrogate %R values are at least 70% of acceptance limit, Data is acceptable	If surrogate %R values are at least 70% of acceptance limit, Data is acceptable	No effect on data	No effect on data

Uncontrolled when printed: Verify latest version on ShawNet/Governance


QC Data Discrepancy	Result Non-detect	Result >10% Below Action-level	Result Within 10% of or Above Action-level	Result Greater than 10% Above Action-level
Surrogate %R High	No effect on data	No effect on data	If surrogate %R values are within 30% of acceptance limit→Data is acceptable	No effect on data
REMEDATION or TREATMENT MONITORING				
Trip Blank Contaminated	No effect	No effect	If TB is greater than 10% of action-level or result→reject data	No effect
Duplicate Precision outside limits	No effect unless Duplicate is either above or within 50% of action-level - in this case qualify sample data and report with Duplicate result as "highest probable value"	No effect unless Duplicate is either above or within 30% of action-level - in this case qualify result as "assumed above action-level"	If Duplicate is either above or within 20% of action-level→qualify result as "assumed above action-level"	No effect-report result even if Duplicate is below action-level
LCB Contaminated	No effect on data	No effect on data	If LCB is greater than 10% of action-level or sample result→Data is unacceptable	No effect on data
LCS Low Recovery	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	No effect on data
LCS High Recovery	No effect on data	No effect on data	If MS/MSD are acceptable or Surrogates are acceptable evaluate for bias→Data accepted	No effect on data
Matrix Spike Low %R	If %R>50 and LCS acceptable-Data accepted	If %R>50 and LCS acceptable-Data accepted	If %R>50 LCS acceptable→Data accepted (evaluate potential low bias in results below action-level)	No effect
Matrix Spike High %R	No effect on data	No effect on data	If MSD and LCS acceptable and Surrogates or Post-spike within range→Data is accepted with precision qualifier	No effect on data

Uncontrolled when printed: Verify latest version on ShawNet/Governance

QC Data Discrepancy	Result Non-detect	Result >10% Below Action-level	Result Within 10% of or Above Action-level	Result Greater than 10% Above Action-level
MS/MSD RPD High	No effect on data unless perceived native concentration in MS or MSD result would be above action-level. In this case, reject data as highly suspect and advise review of sampling and lab sub-sampling procedures	No effect on data unless perceived MS or MSD native concentration would be above action-level. In this case, qualify results as potentially above action-level	If the perceived native result of either the MS or MSD is greater than 110% of action-level→qualify data as being above action-level	No effect on data
Surrogate %R Low	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	No effect on data	No effect on data
Surrogate %R High	No effect on data	No effect on data	If Surrogate %R is greater than 120% of acceptance limit, Data is unacceptable	No effect on data
VERIFICATION or CLOSURE ANALYSIS				
LCB Contaminated	No effect on data Comment LCB contamination	No effect on data Comment LCB contamination	If LCB is greater than 10% of action-level or sample result, Data is unacceptable	If LCB is greater than 10% of action-level or sample result, Data is unacceptable
LCS Low Recovery	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted
LCS High Recovery	No effect on data	No effect on data	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted (evaluate potential bias in reported result)	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted
Matrix Spike Low %R	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier

Uncontrolled when printed: Verify latest version on ShawNet/Governance

QC Data Discrepancy	Result Non-detect	Result >10% Below Action-level	Result Within 10% of or Above Action-level	Result Greater than 10% Above Action-level
Matrix Spike High %R	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier
MS/MSD RPD High	No effect on data	If sample result is greater than 90% of action-level, Data is unacceptable	If RPD is greater than 110% of acceptance limit, Data is unacceptable	If RPD is greater than 110% of acceptance limit, Data is unacceptable
Surrogate %R Low	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable
Surrogate %R High	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are within 20% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are within 20% of acceptance limits and other QC is within acceptance limits, Data is acceptable	If any Surrogate %R is greater than 110% of acceptance limit, Data is unacceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are within 20% of acceptance limits, Data is acceptable

	Document Type: <h1>Discipline-Specific Procedure</h1>	Level: 3 Owner: Applied Science & Engineering Origination Date: 6/5/2003 Revision Date: 8/25/2011
Group: E&I	Title: Shipping and Packaging of Non Hazardous Samples	No: EID-FS-012 Revision No.: 2 Page 1 of 3

Uncontrolled when printed: Verify latest version on ShawNet/Governance

1. PURPOSE

The purpose of this procedure is to provide general instructions in the packaging and shipping of non-hazardous samples. The primary use of this procedure is for the transportation of samples collected on site to be sent off site for physical, chemical, and/or radiological analysis.

2. SCOPE

This procedure applies to the shipping and packaging of all non-hazardous samples. Non-hazardous samples are those that do not meet any hazard class definitions found in 49 CFR 107-178, including materials designated as Class 9 materials and materials that represent Reportable Quantities (hazardous substances) and/or materials that are not classified as *Dangerous Goods* under current IATA regulations.

In general most soil, air, and aqueous samples, including those that are acid or caustic preserved do **not** qualify as *hazardous materials* or *dangerous goods*. An exception is methanolic soil VOC vials: these containers are flammable in any quantity and **must** be packaged, shipped, and declared as *Dangerous Goods* whenever transported by air.

The Class 9 "Environmentally Hazardous" designation should only be applied to samples if they are known or suspected (via screening) to contain a sufficient concentration of contaminant to pose a health and/ or environmental risk if spilled in transport. Samples for which screening has shown a potential hazard (i.e. flammability) or those that are derived from a known hazard, including a site/facility with confirmed contamination by an *infectious substance* must also be shipped in accordance with the applicable DOT/IATA requirements. Refer to Shaw E & I SOP FS013.

Improper shipment of hazardous materials, especially willful misrepresentation and shipment as non-hazardous materials, is a violation of federal law and is punishable by fines and possible imprisonment of the guilty parties. It is also a violation of Shaw E & I policy and can result in disciplinary action up to and including termination of employment.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, EM200-1-3, Washington, D.C.
- U.S. Department of Transportation Regulations, 49 CFR Parts 108-178
- International Air Transport Association (IATA), *Dangerous Goods Regulations*, current edition.

4. DEFINITIONS

- **Cooler/Shipping Container**—Any hard-sided insulated container meeting DOT's or IATA's general packaging requirements.
- **Bubble Wrap**—Plastic sheeting with entrained air bubbles for protective packaging purposes.

Group: E&I	Title: Shipping and Packaging of Non Hazardous Samples	No: EID-FS-012 Revision No.: 2 Page 2 of 3
--------------------------	--	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be sent to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Packaging

- Use tape and seal off the cooler drain on the inside and outside to prevent leakage.
- Place packing material on the bottom on the shipping container (cooler) to provide a soft impact surface.
- Place a large (30-55 gallon or equivalent) plastic bag into the cooler (to minimize possibility of leakage during transit).
- Starting with the largest glass containers, wrap each container with sufficient bubble wrap to ensure the best chance to prevent breakage of the container.
- Pack the largest glass containers in the bottom of the cooler, placing packing material between each of the containers to avoid breakage from bumping.
- Double-bag the ice (chips or cubes) in gallon- or quart-sized resealable plastic freezer bags and wedge the ice bags between the sample bottles.
- Add bagged ice across the top of the samples.
- When sufficiently full, seal the inner protective plastic bag, and place additional packing material on top of the bag to minimize shifting of containers during shipment.
- Tape a gallon-sized resealable plastic bag to the inside of the cooler lid, place the completed chain of custody document inside, and seal the bag shut.
- Tape the shipping container (cooler) shut using packing tape, duct tape, or other tear-resistant adhesive strips. Taping should be performed to ensure the lid cannot open during transport.
- Place a custody seal on two separate portions of the cooler, to provide evidence that the lid has not been opened prior to receipt by the intended recipient.

Group: E&I	Title: Shipping and Packaging of Non Hazardous Samples	No: EID-FS-012 Revision No.: 2 Page 3 of 3
--------------------------	--	--

Uncontrolled when printed: Verify latest version on ShawNet/Governance

6.2 Labeling

- A “This Side Up” arrow should be adhered to all sides of the cooler, especially ones without obvious handles.
- The name and address of the receiver and the shipper must be on the top of the cooler.
- The airbill must be attached to the top of the cooler.

6.3 Shipping Documentation

- A Cooler Shipment Checklist (Attachment 1) should be completed and kept in the project file.

7. ATTACHMENTS

- Attachment 1, Shaw E & I Cooler Shipment Checklist

8. FORMS

None

9. RECORDS

- Chain of Custody Form
- Chain of Custody Continuation Page(s)
- Cooler Shipment Checklist

10. REVISION HISTORY AND APPROVAL

Revision Level	Revision Description	Responsible Manager
Revision Date		
00	Initial issue	N/A
06/05/2003		
01	Updated template and numbering of procedure, content was added to Section 2-Scope	Guy Gallelo
09/08/2006		
02	Modified format only to align with Governance Management framework.	Scott Logan
08/25/2011		



Title:

Shipping and Packaging of Non Hazardous Samples

No: EID-FS-012

Attachment No. 1

Uncontrolled when printed: Verify latest version on ShawNet/Governance

Attachment 1 Sample Shipment Checklist

Project Name	_____	Project Number	_____
Address	_____	Date	_____ Time _____
City, State, Zip	_____	Fax No.	_____
Site Contact No.	_____		

SAMPLE CHECKLIST

YES

NO

COMMENTS

SAMPLE LIDS ARE TIGHT AND CUSTODY SEALS IN PLACE?	<input type="checkbox"/>	<input type="checkbox"/>	_____
ARE ALL SAMPLE NUMBERS, DATES, TIMES AND OTHER LABEL INFORMATION LEGIBLE AND COMPLETE?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAVE ALL SAMPLE NUMBERS, DATES, TIMES AND OTHER SAMPLING DATA BEEN LOGGED INTO THE SAMPLE LOG BOOK?	<input type="checkbox"/>	<input type="checkbox"/>	_____
DO SAMPLE NUMBERS AND SAMPLE DESCRIPTIONS ON THE LABELS MATCH THOSE ON THE COC?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAVE THE SAMPLES BEEN PROPERLY PRESERVED?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAVE THE CHAIN OF CUSTODIES BEEN FILLED OUT COMPLETELY AND CORRECTLY?	<input type="checkbox"/>	<input type="checkbox"/>	_____
DOES THE ANALYTICAL SPECIFIED ON THE COC MATCH THE ANALYTICAL SPECIFIED IN THE SCOPE OF WORK?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAVE THE COC'S BEEN PROPERLY SIGNED IN THE TRANSFER SECTION?	<input type="checkbox"/>	<input type="checkbox"/>	_____

PACKAGING CHECKLIST

YES

NO

COMMENTS

HAS EACH SAMPLE BEEN PLACED INTO AN INDIVIDUAL PLASTIC BAG?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAS THE DRAIN PLUG OF THE COOLER BEEN TAPED CLOSED WITH WATER PROFF TAPE FROM THE INSIDE?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAVE ALL THE SAMPLES BEEN PLACED INTO THE COOLER IN AN UPRIGHT POSITION?	<input type="checkbox"/>	<input type="checkbox"/>	_____
IS THERE ADEQUATE SPACING OF SAMPLES SO THAT THEY WILL NOT TOUCH DURING SHIPMENT?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAVE AN ADEQUATE NUMBER OF BLUE ICE PACKS OR WATER ICE BEEN PLACED AROUND AND ON TOP OF THE SAMPLE?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAS FRESH BLUE ICE OR WATER ICE BEEN ADDED TO THE COOLER THE DAY OF THE SHIPMENT?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAS THE COOLER BEEN FILLED WITH ADDITIONAL CUSHIONING MATERIAL?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAS THE COC BEEN PLACE IN A ZIPLOCK BAG AND TAPED TO THE INSIDE OF THE LID OF THE COOLER?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAVE CUSTODY SEALS BEEN PLACED ONTO THE LID?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAS THE COOLER BEEN LABELED "THIS SIDE UP"?	<input type="checkbox"/>	<input type="checkbox"/>	_____
IF REQUIRED, HAS THE COOLER BEEN LABELED WITH THE DOT PROPER SHIPPING NAME, UN NUMBER AND LABEL?	<input type="checkbox"/>	<input type="checkbox"/>	_____
HAS THE LABORATORY PERFORMING THE ANALYSES BEEN NOTIFIED OF THE SHIPMENT OF SAMPLES?	<input type="checkbox"/>	<input type="checkbox"/>	_____

PROBLEMS/RESOLUTIONS: _____

PREPARED BY: _____ SIGNATURE _____



VB/I-70 Investigation Project-146543

Previous (2002) Standard Operating Procedure Modifications

SOP Soil Sampling-PRI

Modified June 2013 – Guy Gallelo, Jr- Program Chemist

Section 4.3 of the attached SOP from the previous removal action activities provides detail on the pre-removal disposal characterization of property soils. This amendment sheet to the SOP specifies any modifications being made to the referenced SOP in order to execute the task assigned. UFP-QAPP Worksheet 14 may also be referenced.

Section 4.3- Revise last sentence of first paragraph to read

One composite sample and four separate pre-weighed VOC soil plug sets will then be collected from the four properties according to the following procedure:

Step 1- Revise second bullet by adding to the end

At a depth below the top 3-inches also collect an approximate 5-gram VOC plug and eject it into a pre-weighed empty VOC vial using a disposable VOC plug sampler. Immediately cap the VOC vial after placing the 5-gram plug into it.

Step 1- Revise second bullet to read

Repeat this procedure to collect samples from the center of the three remaining sub areas. Place all of the 5-gram VOC plugs into the same pre-weighed VOC vial, making sure to quickly cap it each time a new plug is expelled.

Step 1- Revise the last sentence of the 4th bullet to read

Then fill a 16-oz CWM jar with material and set aside for further mixing.

Step 2- Revise to read

Repeat the procedures in Step 1 at the three remaining properties to produce four 16-oz CWM jars of soil and four pre-weighed VOC vials, each containing four 5-gram VOC plugs.

Step 3- Revise to state that the four 16-oz jars of soil are mixed and then aliquoted to the sample containers. The VOC vials are submitted one per property for analysis.

STANDARD OPERATING PROCEDURE FOR SOIL SAMPLING

1.0 PURPOSE AND SCOPE

The procedures included herein apply to all investigative soil sampling performed during remedial actions for Operable Unit No. 1, Off-Facility Soils, of the VB/I70 Superfund Site. Methods for collecting soil samples from residential properties are provided. Samples will be collected from: 1) garden and flowerbed areas for analysis of arsenic and lead content; 2) yards scheduled for removal for soil composition analyses; and 3) yard excavation areas for analysis of leachate metal, pesticide, herbicide, semi-volatile and volatile constituent concentrations (disposal characteristics).

2.0 TRAINING AND QUALIFICATIONS

All personnel performing these procedures will be trained in the use of these procedures, have significant relevant sampling experience as approved by the project manager and be experienced in sample handling, documentation and shipping.

3.0 EQUIPMENT AND SUPPLIES

The following equipment and supplies will be used to collect investigative soil samples:

- Coring probes, 2-inch minimum diameter, lead-free. The probes must be capable of being forced into hard ground to a depth of up to 6 inches without being damaged. A number of devices can be utilized as a coring probe. Examples include: plastic or steel pipe and a professional stainless steel coring probe equipped with plastic liners, cross T-bar, and hammer.
- Stainless steel bowls, two gallon size or larger.
- Stainless steel spoon, large serving size.
- Shovel, standard size.
- Sample collection container, new containers of the size and type specified in the project Construction Quality Assurance Plan (CQAP) for the sample.

- Steel or plastic measuring tape or ruler, divisions to at least 1/8 inch.
- Field notebooks, bound with individually numbered pages, see Section 4.
- Indelible ink marker, black or blue.
- Ink pens, black or blue.
- Packaging tape, used for sealing shipping containers.
- Plastic bags, trash bags with ties.
- Plastic gloves, powderless. Gloves with powder should not be used to avoid potential contamination of samples from powder material.
- Preprinted field forms (Exterior & Sample Location Map forms) preprinted with sufficient entry lines to address documentation needs presented in subsection.
- Shipping containers, cardboard or plastic for interim storage and shipment of sample collection containers.

4.0 SAMPLE COLLECTION PROCEDURES

The objectives of the residential sampling program and procedures for identifying properties to be sampled are described in the project CQAP. Soil samples will be collected from gardens and flowerbed areas and from yard excavation areas according to the following procedures.

4.1 Garden and Flowerbed Sampling

Soil samples will be collected from each garden or flowerbed sampling unit by subdividing the sampling unit into two approximately equal-sized sub areas. One soil sample will then be collected from the 0 to 2 inch depth interval at the approximate center of each sub area and composited according to the following procedure:

1. At the subsample location, begin by clearing a circular area approximately 4 inches in diameter of any surface covering such as mulch, loose debris, vegetation or sod (if present).

2. Advance the decontaminated coring probe into the underlying soil to the required 2-inch depth. Retrieve the coring probe and remove the collected soil into a decontaminated bowl. Verify with the tape measure or ruler that soil has been collected over the full 0 to 2 inch depth interval.
3. Repeat steps 1 and 2 at the center of the second sub area.
4. Thoroughly homogenize the soil in the bowl using a decontaminated stainless steel spoon. Then scoop soil from random locations in the bowl into the sampling container until the sampling container has been filled. If any large rock fragments or large foreign materials (e.g., paper or plastic trash, nails, etc.) are present, these may be removed from the sample container. Seal and label the container.
5. Fill the probe holes with the left over soil from the bowl, tamp down fill and replace vegetation or sod over fill surface.

Equipment used to collect the soil samples will be decontaminated after each sampling unit. However, it will not be necessary to decontaminate the sampling equipment between sub areas that comprise a single sample. Decontamination procedures are provided in the SOP for Sampling Equipment Decontamination.

4.2 Yard Composition Sampling

A soil sample will be collected from each yard selected for soil composition sampling. The soil sample will be collected from the 0 to 12 inch depth interval near the center of the yard according to the following procedure:

1. At the sample location, begin by clearing a circular area approximately 18 inches in diameter of any surface covering such as mulch, loose debris, vegetation or sod (if present).
2. Using a shovel that is free of accumulated solids, retrieve soil evenly from the 0 to 12 inch depth interval and place it into a clean 5 gallon bucket. Repeat until bucket is approximately $\frac{3}{4}$ full. Cover the bucket with a clean lid.
3. Fill the soil hole with commercially available topsoil or potting soil and tamp down.

Shovels used to collect the soil shall be cleaned by scraping off any accumulated soil and leaving the soil at the sampling location. It will not be necessary to decontaminate the sampling equipment used to collect the yard composition samples.

4.3 Disposal Characteristics Sampling

One composite sample will be collected from every twenty properties scheduled for remediation. The composite sample will be prepared by randomly selecting four of the properties for sampling using a spreadsheet-based random number generator routine. One composite sample will then be collected from the four properties according to the following procedure:

1. At each selected property, the exposed soil areas (yards, unpaved driveways and unpaved parking areas) will be subdivided into four approximately equal-sized sampling units (sub areas). One soil sample will then be collected from the approximate center of each sub area as follows:
 - Begin by clearing a circular area approximately 4 inches in diameter of any surface covering such as mulch, loose debris, vegetation or sod (if present).
 - Advance the decontaminated coring probe into the underlying soil until it is full. Retrieve the coring probe and remove the collected soil into a decontaminated bowl. Repeat this procedure until soil has been collected over the full 0 to 12 inch depth interval, as verified with the tape measure or ruler.
 - Repeat this procedure to collect samples from the center of the three remaining sub areas.
 - Thoroughly homogenize the soil in the bowl. Then remove a volume slightly greater than $\frac{1}{4}$ of the sample container by scooping soil from random locations in the bowl into a second decontaminated bowl.
 - Fill the probe holes with soil from the original bowl, tamp down fill and replace vegetation or sod over fill surface.
2. Repeat the procedures in Step 1 at the three remaining properties to produce four bowls of homogenized soil.
3. Next combine and thoroughly homogenize the four bowls of soil in a single decontaminated bowl. Scoop soil from random locations in the final bowl into the sampling container until the sampling container has been filled. If any large rock fragments or large foreign materials (e.g., paper or plastic trash, nails, etc.)

are present, these may be removed from the sample container. Seal and label the container.

Equipment used to collect the soil samples will be decontaminated after the final composite sample is collected. However, it will not be necessary to decontaminate the sampling equipment between yards that comprise a single sample. Decontamination procedures are provided in the SOP for Sampling Equipment Decontamination.

4.4 Documentation

The sampling team will maintain field notes describing date and time of sampling, weather conditions, personnel present, special instructions, property contact information and sample numbers and sample storage or shipping information. The following information will also be recorded on the Soil Sampling Form:

- Date
- Property block and lot number (if available)
- Property address
- Sampling team members
- Sample numbers
- Location description, including depth
- Soil description

In addition, a site map will be prepared to show the location of the main residence, garage, and significant outbuildings, approximate property boundaries, garden and flowerbed areas, and sample locations. The sub sample locations will be clearly labeled, and the areas represented by each composite sample will be delineated on the site map. This information will be recorded on an Exterior & Sample Location Map form (attached). The Exterior & Sample Location Map form will be forwarded to the Supervising Contractor's Project Manager for inclusion in the hard copy property file.

Sample custody procedures (sample delivery and pick-up information) will be followed in accordance with the SOP for Sample Handling and Documentation. A copy of chain-of-custody form will be included in the hard copy property file.

5.0 EQUIPMENT CALIBRATION AND MAINTENANCE

Soil sampling equipment will be inspected for damage or wear after each sampling day. Worn or unusable equipment will be replaced immediately.

6.0 REFERENCES

U.S. Environmental Protection Agency, 1995. Residential Sampling for Lead: Protocols for Dust and Soil Sampling, EPA Doc. No. 747-R-95-001, March.



VB/I-70 Investigation Project-146543

Previous (2002) Standard Operating Procedure Modifications

SOP Fill Materials-PRI

Modified June 2013 – Guy Gallelo, Jr- Program Chemist

The attached SOP from the previous removal action activities provides detail on the collection of fill material samples to verify usability. This amendment sheet to the SOP specifies any modifications being made to the referenced SOP in order to execute the task assigned. UFP-QAPP Worksheet 14 may also be referenced.

Section 3.2- Add a new sentence to read

Samples for VOCs (topsoil only) will be collected as a 5-gram soil plug into a pre-weighed empty VOC vial, per Method 5035A.

STANDARD OPERATING PROCEDURE FOR SAMPLING REPLACEMENT MATERIALS

1.0 PURPOSE AND SCOPE

These procedures apply to sampling of replacement materials used in remedial actions for Operable Unit No. 1, Off-Facility Soils, of the VB/I70 Superfund Site. Methods for collecting samples of the replacement soil are provided. Samples of the replacement soils will be collected and analyzed for: 1) physical properties, 2) arsenic and lead content and 3) selected metals, pesticides, herbicides, semi-volatiles, volatiles and PCBs. Samples of replacement road base and gravel will be collected and analyzed for: 1) physical properties and 2) arsenic and lead content.

2.0 TRAINING AND QUALIFICATIONS

All personnel performing these procedures must be trained in their use and experienced in soil sampling, sample handling and sample shipping, as approved by the project manager.

3.0 PROCEDURES

Grab samples of clean replacement materials will be collected from transport trucks, material stockpile or directly following placement.

3.1 Equipment

The following is a list of equipment needed to collect the replacement samples.

- Sample collection container: new containers of the size and type specified in the Construction Quality Assurance Project Plan (CQAP)
- Plastic or stainless steel spoon, trowel or shovel
- Field notebook
- Clipboard
- Indelible ink marker
- Plastic bags for trash

3.2 Sample Collection Procedures

Each sample will be a single grab sample. Grab samples will be collected by directly

scooping materials from the transport truck, stockpile or final placement location. The sampler will randomly select sampling locations. Sampling will be performed at the frequency specified in the CQAP.

3.3 Documentation

The following information will be recorded on the sample label and in a field notebook for each fill sample:

- Date and time of sampling
- Sampler name
- Sample location
- Original source of fill
- Notes from visual inspection of material, including size, type of materials, etc.
- Sample number identifier
- Analyses requested
- Laboratory

This information will be retained by the Supervising Contractor's Field Project Supervisor in hard copy files.

Attachment 3

Colorado State University Procedures

WESTERN STATES AGRICULTURAL LABORATORY EXCHANGE PROGRAM

SUGGESTED SOIL AND PLANT ANALYTICAL METHODS¹

1994 (Proposed)

Version 1.00

¹ From Recommended Soil and Plant Tissue Reference Methods for the Western States. 1993. R. G. Gavlak, D. A. Horneck, and R. O. Miller. In Press.

Scope and Application

This method semi-quantifies the soil pH based on a saturation paste. Soil pH is a measure of the relative acidity or alkalinity of the soil solution that is in equilibrium with the solid particles. It is a measure of the intensity of acidity or alkalinity, but does not indicate the relative buffering capacity of the soil. It is most applicable to salt-affected soils with a pH ranging from 6.0 to 9.0 (Robbins et. al. 1990). Soil pH is measured to access soil chemical properties, crop suitability, lime needs and relative nutrient availability. The method is generally reproducible within ± 0.1 pH units.

Equipment

1. pH meter, equipped with pH electrodes (indicating and reference).
2. Primary standard buffers, pH 4.0, 7.0, and 10.0.

Procedure

1. Prepare a saturation paste, as outlined in Method S - 1.00.
2. Standardize / Calibrate the pH meter: (1) rinse electrode with deionized water and place in pH 7.0 primary standard buffer and adjust as necessary; (2) rinse electrode and place in pH 4.0 primary standard buffer; (3) adjust the slope until response is ± 0.05 units of expected response; and (4) check pH 7.0 primary standard buffer and adjust as necessary (See Comment #1). For high pH soils (> 7.0) use pH buffers 7.0 and 10.0.
3. Insert electrode into soil paste and gently rotate the container to remove entrapped air. When the meter has stabilized record soil pH as pH_{sp} to the nearest 0.1 pH unit.
4. Remove electrode(s), rinse with deionized water and blot excess water with filter paper (See Comment #2).

Comments

1. Follow manufacturer's guidelines if meter does not read within 0.05 units of primary standards. Maintenance of combination electrodes differs from that of separate reference and glass electrodes; refer to manufacturer's instructions.
2. Store pH electrodes according to manufacturer's instructions (recommended practice is to store the electrodes in a primary standard buffer).

Literature

Rhoades, J.D. and S. Miyamoto. 1990. Testing Soils for Salinity. p. 299-336. *In*: R.L. Westerman (ed.) Soil Testing and Plant Analysis. 3rd ed. SSSA, Madison, WI.

Robbins, C.W. and C.L. Wiegand. 1990. Field and Laboratory measurements. p. 201-219. *In*: K.K. Tanji (ed.) ASCE manuals and Reports No. 71, Agricultural Salinity, Assessment, and Management American Society of Civil Engineers, 245 E. 47th St., New York.

U.S. Salinity Lab. Staff. 1954. Saturated Soil Paste. Diagnosis and Improvement of Saline and Alkali Soils. Agr. Handbook 60, USDA, Washington, D.C.

Scope and Application

This method semiquantifies the amount of dissolved salts (mg L^{-1}) by measurement of the electrical conductivity (EC_e) of the saturation paste extract. The relationship between EC_e and soluble salts is approximate due to differences in equivalent weights, ion equivalent conductivities, and relative proportions of major solutes in the paste extracts (Robbins, 1990). The EC_e measurement is sensitive to temperature and increases approximately 2 % per °C (range 15 - 35 °C). All EC_e data is normalized to 25 °C. Salt tolerance crop data is generally expressed in terms of the (EC_e) of the saturation paste extract. The method detection limit is approximately 0.01 dS m^{-1} (mmhos cm^{-1}) and is generally reproducible within $\pm 7 \%$.

Equipment

1. Conductivity cell and conductivity meter with dynamic range from 0.01 to 100 dS m^{-1} conductance, temperature compensating, 25 °C.

Reagents

1. Deionized water, ASTM Type I grade.
2. Standard Reference Solution. Dissolve 0.7456 g KCl in deionized water and dilute to 1.0 L . At 25 °C a 0.010 N KCl solution will have a EC_e of 1.412 dS m^{-1} (mmhos cm^{-1}). For a 0.100 N KCl solution (7.456 g KCl diluted to 1.0 L) will have an EC_e of 12.900 dS m^{-1} . Standard calibration solutions can be purchased from a scientific vendor.

Procedure

1. Prepare a saturation paste, as described in Method S - 1.00, and retain extract for EC_e measurement.
2. Equilibrate extract to 25 °C temperature. Set scale to correct range, set temperature calibration and calibrate EC_e by drawing 2.0 mL of 0.010 N KCl solution into conductance cell. EC_e value should be 1.412 dS m^{-1} (mmhos cm^{-1}) conductance. Operate and adjust instrument in accordance with manufacturer's instructions.
3. Rinse conductance cell with deionized water. Draw approximately 2 mL of soil saturation paste extract solution into conductance cell and adjust range. When the meter has stabilized record instrument reading.

Calculations

Report EC_e to the nearest 0.01 dS m^{-1} as EC_e .

(See Comments #1, #2, and #3)

Comments

1. The relationship between conductivity and soluble salts is approximate due to differences in solutes, solute conductivities, and equivalent weights. The general relationship (for solutions with an EC_e range of 0.10 - 2.0 dS m^{-1}) is:

Dissolved Salt Concentration (mg L^{-1}) $\cong 640 \times EC_e$, in dS m^{-1}

Total Cations (or Anions) (mmolc L^{-1}) $\cong 10 \times EC_e$, in dS m^{-1}

Osmotic Potential (bars) $\cong 0.39 \times EC_e$, in dS m^{-1}

The factor for converting EC_e to total dissolved salts (mg L^{-1}) ranges from 550 to 900 dependent on the specific anions present and their concentration. For estimating approximate total cations or anions, USDA Handbook #60, Figure 4, graphically shows this relationship for typical salt concentrations.

2. Plant sensitivity to saturation paste extract electrical conductivity is as follows:

dS m^{-1}	Plant salinity effects
0 - 2	salinity effects negligible (bean, carrot, onion, strawberry)
2 - 4	very sensitive crops affected (spinach, citrus, alfalfa)
4 - 8	moderately salt tolerant crops affected (tomato, beet, wheat)
8 - 16	only salt tolerant crops yield satisfactory (barley, cotton, asparagus)
> 16	few salt crops yield satisfactory

3. For highly saline soils calibrate using 0.100 N KCl solution, EC_e 12.900 dS m^{-1} .

Literature

Hanson, Blaine, Stephen R. Grattan, and Allan Fulton. 1993. Agricultural Salinity and Drainage. University of California Irrigation Program, Univ. California Davis.

Rhoades, J.D. and S. Miyamoto. 1990. Testing Soils for Salinity. p. 299-336. In: R.L. Westerman (ed.) Soil Testing and Plant Analysis. 3rd ed. SSSA, Madison, WI.

Robbins, C.W. and C.L. Wiegand. 1990. Field and Laboratory measurements. p. 201-219. In: K.K. Tanji (ed.) ASCE manuals and Reports No. 71, Agricultural Salinity, Assessment, and Management American Society of Civil Engineers, 245 E. 47th St., New York.

Determination: 1985. Method 205 Conductivity. p. 76-78. In: A.H. Franson (ed.) Standard methods for the examination of waste water. 16th edition. American Public Health Association, American Water Works Association and Water Pollution Control Federation.

U.S. Salinity Lab. Staff. 1954. Saturated Soil Paste. Diagnosis and Improvement of Saline and Alkali Soils. Agr. Handbook 60, USDA, Washington, D.C.

SOIL NITRATE NITROGEN
Ammonium Bicarbonate-DTPA
Extraction / Cd-Reduction Method

Scope and Application

This method involves the quantitative extraction of nitrate ($\text{NO}_3\text{-N}$) from soils using ammonium bicarbonate-DTPA. Nitrate is determined by reduction to nitrite via a cadmium reactor, diazotized with sulfanilamide and is coupled to N-(1-Naphthyl)-ethylenediamine dihydrochloride to form an azochromophore (red-purple in color) which is measured spectrophotometrically at 540 nm. The method is readily adapted to manual or automated techniques. Cadmium is a hazardous material. Follow manufacturers recommendations in handling this material. Soil inorganic nitrogen can be used to predict plant response to nitrogen fertilizers. The method detection limit is approximately 0.1 mg kg⁻¹ (on a dry soil basis) and is generally reproducible $\pm 5\%$.

Equipment

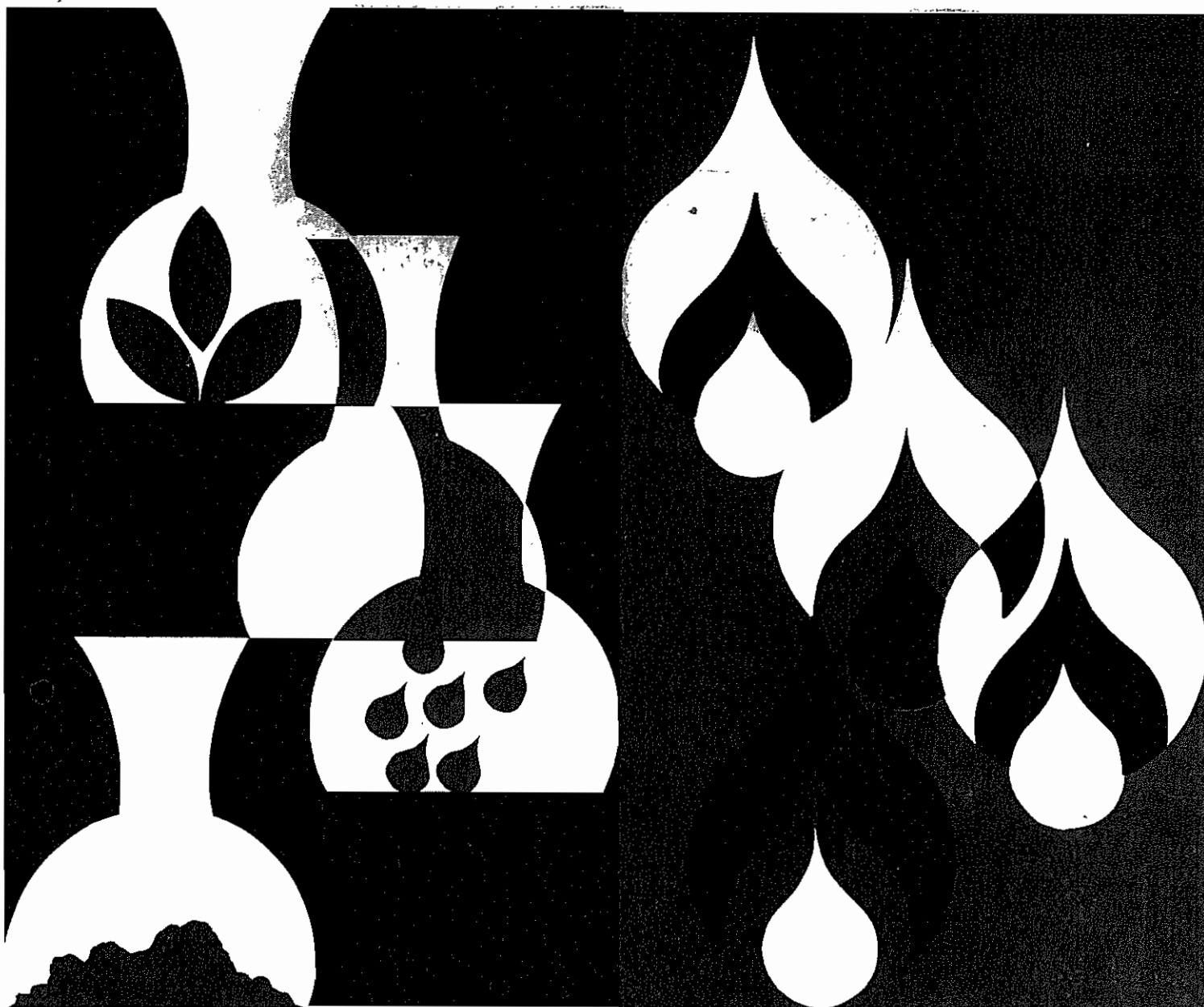
1. Analytical balance,; 1000 g capacity, resolution ± 0.01 g.
2. Repipette dispenser, calibrated to 25.0 ± 0.2 mL.
3. Reciprocating mechanical shaker, capable of 180 oscillations per minute.
4. Whatman No. 42 or equivalent highly retentive filter paper.
5. Spectrophotometer, autoanalyzer, or flow injection analyzer (FIA) instrument.

Reagents

1. Deionized water, ASTM Type I grade.
2. DTPA: Dissolve 9.85g of diethylenetriaminepentaacetic acid in about 4.5L of DI water. Mix for about 5 hours to dissolve.
3. Ammonium bicarbonate-DTPA: Very gently dissolve 79.06g ammonium bicarbonate in about 900 mL of water. The pH after dissolution should be about 7.6.
4. Nitrate-N standards: Mix standards in AB-DTPA at 0, 2.5, 5.0, 10.0 and 20.0 ppm $\text{NO}_3\text{-N}$

Procedure

1. Weigh 10.0 ± 0.05 g of air-dried pulverized soil (< 2 mm) into extraction vessel. Add 20.0 mL of AB-DTPA reagent using repipette dispenser (See Comment #2). Include a method Blank and a check sample
2. Shake for 15 min. and then filter through Whatman 1 filter paper.
3. Nitrate-N content of the extract is determined using a OI Analytical Flow Solution 3000 Calibrate using standard calibration solutions and operate instrument in accordance with manufacturer instructions. Determine nitrate concentration of AB-DTPA extract, method blank, unknown samples. Include the dilution factor in the FIA program and record results as mg/kg of nitrate-N in the extract solution.



COLORADO
STATE
UNIVERSITY
EXPERIMENT
STATION
FORT COLLINS
TECHNICAL
BULLETIN 142

**SOIL-TESTING METHODS
USED AT
COLORADO STATE UNIVERSITY
SOIL TESTING LABORATORY**
FOR THE EVALUATION
OF FERTILITY,
SALINITY, SODICITY AND
TRACE ELEMENT TOXICITY

EXPERIMENT STATION

LIME TEST (SEMI-QUANTITATIVE)

The lime test currently used in the CSU Soil Testing Laboratory for routine sample analysis is simply a semi-quantitative test. Sulfuric acid (0.4 N) is added to a small sample of dry soil. Depending upon the degree of effervescence, samples are categorized as to high, medium, or low lime content. Low = <1%, Medium = 1 - 2%, High = >2% lime.

NH₄HCO₃-DTPA EXTRACTION PROCEDURE FOR AVAILABLE NUTRIENTS AND TRACE ELEMENTS

The NH₄HCO₃-DTPA soil test was developed to simultaneously extract P, K, Zn, Fe, Cu and Mn. The method also can be used to evaluate the availability and toxicity of trace elements such as Pb, Ni, Cd, Mo, B, As and Se.

A. Extracting Solution

Dissolve 1.97 grams of DTPA in 800 milliliters of water. Approximately 2 milliliters of 1:1 NH₄OH is added to facilitate dissolution. After the DTPA is in solution, add 79.06 grams NH₄HCO₃ and stir gently until dissolved. Adjust the pH to 7.6 using either NH₄OH or HCl. Bring to a final volume of 1 liter.

B. Extracting Procedure

1. Place 10 grams of soil in a 125 milliliter Erlenmeyer flask.
2. Add 20 milliliters of extracting solution and shake 15 minutes on a reciprocating shaker at 180 cycles per minute. The flasks are kept open.
3. Filter through a medium speed filter paper.

C. Comments

The extracting solution is unstable with regard to pH and should be made fresh before using. The effervescent nature of the solution can cause the calibrations of automatic dispensers to be in error. Be sure that 20 milliliters are delivered to each sample.

D. References

1. Soltanpour, P.N. and A.P. Schwab, 1977. A new soil test for simultaneous extraction of macro- and micro-nutrients in alkaline soils. Comm. in Soil Sci. and Plant Anal. 8:195-207.
2. Soltanpour, P.N. and S. Workman, 1979. Modification of the NH₄HCO₃-DTPA soil test to omit carbon black. Comm. in Soil Sci. and Plant Anal. 10:1411-1420.

NO₃-N
40
20
10
5
0

P
20
10
5
2.5
0

DETERMINATION OF INORGANIC PHOSPHORUS IN AB-DTPA EXTRACTS

This method is based on the reduction of the ammonium phosphomolybdate complex by ascorbic acid in the presence of antimony.

A. Reagents

1. Mixed Reagent

- Dissolve 12.7 grams of ammonium molybdate in 250 milliliters of distilled water.
- Dissolve 0.291 grams of antimony potassium tartrate in 100 milliliters of distilled water.
- Add both of the dissolved reagents into 1,000 milliliters of 5 N H₂SO₄ (148 milliliters concentrated H₂SO₄ per liter), mix thoroughly and make to 2,000 milliliters with distilled water.

2. Color Developing Reagent

Dissolve 0.74 grams of ascorbic acid in 140 milliliters of mixed reagent. This reagent should be prepared when needed since it is not stable for more than 24 hours.

B. Standards

- 1,000 micrograms per milliliter P = 4.3937 grams oven-dried KH₂PO₄ per liter
- Dilute the 1,000 micrograms per milliliter P stock solution to make standards containing 0, 5, 10, 15, 20 and 30 micrograms per milliliter P. The standards should be made up in the AB-DTPA extracting solution.

C. Procedure

- Place a 0.25 milliliter aliquot of an AB-DTPA soil extract or standard in a 2.5 centimeter matching spectrometric tube.
- Add 10 milliliters distilled water.
- Add 2.25 milliliters of color developing reagent and mix well.
- Read at 880 nanometers between 10 minutes and one hour after adding the color developing reagent. 100 w/blank

D. Calculations

$$\mu\text{g/g P} = \mu\text{g/ml P}(\text{curve}) \times \frac{\text{vol. of extracting solution(ml)}}{\text{Wt. of soil (g)}}$$

For AB-DTPA extract of 10 grams soil with 20 milliliters of solution:

$$\mu\text{g/g P} = \mu\text{g/ml P}(\text{curve}) \times 2$$

E. Reference

1. Watanabe, F.S., and S.R. Olsen, 1965. Test of an ascorbic acid method for determining phosphorus in water and NaHCO_3 extracts from soil. Soil Sci. Soc. Amer. Proc., 29:677-678.

DETERMINATION OF P, K, Zn, Fe, Mn, Cu, Cd, Pb, Ni, Mo, B, As AND Se IN AB-DTPA
SOIL EXTRACTS USING ICP-AES

Inductively coupled plasma atomic emission spectrometry (ICP-AES) is a sensitive and convenient tool for determining elements in solution. AB-DTPA soil extracts are analyzed easily, using ICP-AES since most elements are present in concentrations higher than the detection limits and spectral interferences usually are negligible.

A. Standards

Because of the linearity of ICP standard curves only two standards usually are used to standardize an element. One standard contains a low concentration of the element, and one contains a higher concentration. The standards must be made in the AB-DTPA extracting solution. The following solutions are used to standardize the ICP for analyzing AB-DTPA soil extracts:

1. Low standard: AB-DTPA blank
2. High standard for P, K, Zn, Fe, Mn, Cu, Pb, Cd, Ni, Mo, B, As, Se, Ca, Mg, Na

Element	Soil µg/g	Solution µg/ml	ml Stock/500ml	Stock Solution µg/ml
P	20	10	5	1000
K	200	100	25	2000
Zn	10	5	2.5	1000
Fe	10	5	2.5	1000
Mn	10	5	2.5	1000
Cu	10	5	2.5	1000
Pb	2	1	0.5	1000
Cd	2	1	0.5	1000
Ni	2	1	0.5	1000
Mo	2	1	0.5	1000
B	2	1	0.5	1000
As	2	1	0.5	1000
Se	2	1	0.5	1000
Ca	200	100	25	2000
Mg	200	100	25	2000
Na	200	100	25	2000

Stock Solutions:

- a. Zn, Fe, Mn, Cu, Pb, Cd, Ni, Mo, B, As, Se - commercially available
1,000 micrograms per milliliter atomic absorption standards.
- b. P - 1,000 micrograms per milliliter = 1.856 grams $\text{NH}_4\text{H}_2\text{PO}_4$ per
500 milliliters.
- c. Ca, Mg, Na, K -
2,000 µg/ml
Ca, Mg, Na, K
2.500g CaCO_3
1.000g Mg metal
2.5413g NaCl
1.9066g KCl
Dissolved
in
500 ml

Dissolve the Mg metal and CaCO_3 first in 5 milliliters of concentrated HCl, then dissolve the NaCl and KCl and dilute to volume.

3. High Standard for Cr, Sr, Ba, Al, Ti, Hg

<u>Element</u>	<u>Soil μg/g</u>	<u>Solution μg/ml</u>	<u>mg Stock/500 ml</u>	<u>Stock Solution μg/ml</u>
Cr	2	1	0.5	1000
Sr	2	1	0.5	1000
Ba	2	1	0.5	1000
Al	2	1	0.5	1000
Ti	2	1	0.5	1000
Hg	2	1	0.5	1000

The stock solutions are commercially available 1,000 micrograms per milliliter atomic absorption standards.

B. Procedure

1. Place 0.25 milliliters of concentrated HNO_3 in a 10 milliliter beaker.
2. Carefully add 2.5 milliliters of sample or standard and mix on a rotary shaker for 15 minutes to drive off CO_2 .
3. Analyze on ICP.

C. Interelemental Interferences

Usually interelemental interferences in AB-DTPA extracts are small enough to be ignored. Two of the more common spectral interferences in AB-DTPA extracts are Mg on P (2149\AA^0) and Fe on B (2497\AA^0). The analyst should be aware that other spectral interferences may be significant.

Interelemental interference correction factors can be determined empirically by analyzing solutions containing only an interfering element and observing the apparent concentrations of the other elements. Interference correction factors consist of the amount of interference produced by 1 microgram per milliliter of interfering element. The apparent concentration caused by an interfering element is calculated by multiplying the concentration of the interfering element occurring in the sample by the appropriate interference correction factor. The apparent concentrations due to spectral interferences are then subtracted from the uncorrected concentrations to give corrected concentrations.

D. Comments

1. Acidification of AB-DTPA extract is essential. Without acidification carbonates precipitate at the nebulizer capillary tips causing unsteady signals.

2. Magnesium is the only element being determined in the AB-DTPA extracts that has a standard curve, which is not linear over at least two orders of magnitude. A standard curve using three or more points should be used. This curve is stored in the computer and restandardization is accomplished by running only a low and high standard.
3. Arsenic and selenium usually are below the detection limit or have severe spectral interferences. Hydride generation may be used to overcome these problems.

E. Reference

1. Soltanpour, P.N., S.M. Workman, and A.P. Schwab, 1979. Use of inductively-coupled plasma spectrometry for the simultaneous determination of macro- and micronutrients in NH_4HCO_3 -DTPA extracts of soils. Soil Sci. Soc. Amer. J. 43:75-78.
2. Soltanpour, P.N., J.B. Jones and S.M. Workman. 1982. Optical emission spectrophotometry. In Methods of Soil Analysis (A.L. Page, ed.), part 2, Chemical and microbiological properties. Agron. Monograph No. 9 (2nd edition).

$\frac{20}{1.4}$
 14.3
 2 (50)
 1
 7
 230
 15

Methods of Soil Analysis

Part 3—Chemical Methods



SSSA Book Series No. 5 | Edited by: D.L. Sparks

in highly reduced soils, and errors may lie in undried samples of anaerobic soils. Walkley (1947) found that thorough air-drying in oxidation of Fe^{2+} to Fe^{3+} and subsequent. The amounts of Fe^{2+} present in well-aerated amounts of organic C present that not only is oxidized during treatment of soils containing pyrite sulfur concentrations $>0.29\%$ of organic C by the Walkley and Black method (iron (Fe^0) present in soil samples also in dichromate methods, (Allison, 1935), are taken to ensure that soils are not ground to a fine state. The higher oxides of Mn (largely insoluble substances when heated in an acid



will give a negative error when soils are analyzed, though soils contain substantial amounts of Mn. Walkley (1947) and Heanes (1984) concluded that the reactive (reducible) oxides of Mn is small and MnO_2 will take part in redox reactions. If only a small fraction of the MnO_2 present is oxidized, then the oxidation of organic C compounds. Therefore, the use of MnO_2 to be a serious error in the vast majority of cases. Inactive MnO_2 , Walkley (1947) suggested the use of a certain amount of FeSO_4 necessary to reduce the amount of $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2SO_4 . Dichromate methods involve assumptions about the amount of organic C in soils (i.e., equivalent weight of organic C from soils. All dichromate methods assume that soil has an average oxidation state of zero and is equivalent when reacted with dichromate. These methods have been conducted to evaluate this method using extensive heating followed by wet or dry combustion where this assumption is reasonably correct. Little or no external heating give very low recovery in carbonized materials (e.g., charcoal, peat). Walkley (1947) found that the Walkley method recovered 11% of the organic C present in such samples; and Jenkinson (1960b) found that the recovery (0–57%) of organic C from carbonized materials involving external heat such as those of peat, wood, or variable recovery of organic C from such materials and that very little organic C in charcoal

or coke was oxidized by a tube digestion procedure at 135°C . Other investigators have found that the Walkley and Black procedure completely recovers C in weathered coal seams, i.e., coal "blooms" (Kalisz & Sainju, 1991). These conflicting results suggest that recovery of organic C from carbonized materials is highly dependent upon the characteristics of the materials and digestion conditions (i.e., temperature, reagent concentrations). It is appropriate to conclude that dichromate methods cannot be used to quantitatively recover carbonized materials from soils or to discriminate between C in carbonized materials and C in soil organic matter because organic C recovery varies with type of carbonized material and time and temperature of heating of the chromic acid mixture. Therefore, unreliable results for organic C will be obtained if dichromate methods are applied to soils containing significant amounts of carbonized materials. Dry combustion methods are most appropriate for soils containing large amounts of elemental C.

Walkley-Black Method

The Walkley-Black Method was described by Walkley (1946), Peech et al. (1947) and Greweling and Peech (1960).

Reagents

1. Potassium dichromate, 0.167 M (1 N): Dissolve 49.04 g of reagent-grade $\text{K}_2\text{Cr}_2\text{O}_7$ (dried at 105°C) in water, and dilute the reslution to a volume of 1000 mL.
2. Sulfuric acid, concentrated (not less than 96%): If Cl^- is present in soil, add Ag_2SO_4 to the acid at the rate of 15 g per liter.
3. Phosphoric acid, concentrated.
4. *o*-Phenanthroline-ferrous complex, 0.025 M: Dissolve 14.85 g of *o*-phenanthroline monohydrate and 6.95 g of ferrous sulfate heptahydrate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) in water. Dilute the solution to a volume of 1000 mL. The *o*-phenanthroline-ferrous complex is available under the name of Ferroin from the G. Frederick Smith Chemical Co. (Columbus, OH).
5. Barium diphenylamine sulfonate: Prepare a 0.16% aqueous solution. This reagent is an optional substitute for no. 4.
6. Ferrous sulfate heptahydrate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) solution, 0.5 M (0.5 N): Dissolve 140 g of reagent-grade $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in water, add 15 mL of concentrated sulfuric acid, cool the solution, and dilute it to a volume of 1000 mL. Standardize this reagent daily by titrating it against 10 mL of 0.167 M (1 N) potassium dichromate, as described below.

Procedure

Grind the soil to pass through a 0.5-mm sieve, avoiding iron or steel mortars. Transfer a weighed sample, containing 10 to 25 mg of organic C, but not in excess of 10 g of soil, into a 500-mL wide-mouth Erlenmeyer flask. Add 10 mL of 0.167 M (1 N) $\text{K}_2\text{Cr}_2\text{O}_7$, and swirl the flask gently to disperse the soil in the solution. Then rapidly add 20 mL of concentrated H_2SO_4 , directing the stream into the suspension. Immediately swirl the flask gently until soil and reagents are mixed, then more vigorously for a total of 1 min. Allow the flask to stand on an

insulated sheet for about 30 min. Then add 200 mL of water to the flask, and filter the suspension using an acid resistant filter paper (e.g., Whatman 540), if experience shows that the end point of the titration cannot otherwise be clearly discerned. Add three to four drops of *o*-phenanthroline indicator and titrate the solution with 0.5 *M* (0.5 *N*) FeSO_4 . As the end point is approached, the solution takes on a greenish cast and then changes to a dark green. At this point, add the ferrous sulfate heptahydrate drop by drop until the color changes sharply from blue to red (maroon color in reflected light against a white background). Make a blank determination in the same manner, but without soil, to standardize the $\text{K}_2\text{Cr}_2\text{O}_7$. Repeat the determination with less soil if >75% of the dichromate is reduced.

Calculate the results according to the following formula, using a correction factor "*f*" = 1.30 or a more suitable value found experimentally

$$\text{Organic C, \%} = \frac{(\text{mL}_{\text{blank}} - \text{mL}_{\text{sample}}) (M_{\text{Fe}^{2+}}) (0.003) (100)}{\text{wt.} \cdot \text{water-free soil, g}} \times f \quad [12]$$

Comments

The coefficient of variation for the Walkley-Black procedure has been reported to vary between 1.6 and 4.2% (Table 34-3). Ferrous ammonium sulfate also is a suitable titrant for excess $\text{Cr}_2\text{O}_7^{2-}$ in conjunction with the Walkley-Black method. The Smith and Weldon (1941) modification involving complete reduction of $\text{Cr}_2\text{O}_7^{2-}$ with Fe^{2+} , and subsequent back-titration of excess Fe^{2+} with MnO_4^- solution also may be used to estimate unreacted $\text{Cr}_2\text{O}_7^{2-}$. Other oxidation-reduction indicators that have provided satisfactory results include barium diphenylamine sulfonate and *N*-phenylanthranilic acid. The amounts of $\text{Cr}_2\text{O}_7^{2-}$ reduced to Cr^{3+} by reaction with soil organic matter also may be estimated colorimetrically or by potentiometric titration with a ferrous ammonium sulfate solution. Grinding samples to <0.2 mm has been shown to reduce sampling errors and the coefficient of variation even when relatively large sample sizes (1 g) are used (Metson et al., 1979). Heanes (1984) reported that reduction in particle size from 0.5 to 0.15 mm significantly increased recovery of organic C in 12 soils.

Tube Digestion Method

Special Apparatus

1. Pyrex digestion tubes (100 mL) sized for block digester.
2. Block digester: 40-tube Kjeldahl block digester supplied by Technicon Instruments Corp., Tarrytown, NY, or Tecator Inc., Herndon, VA, or equivalent.

Reagents

1. Potassium dichromate solution, 0.167 *M* (1.0 *N*)—dissolve 49.025 of $\text{K}_2\text{Cr}_2\text{O}_7$ (dried at 140°C) in 800 mL of distilled water and dilute the solution with water to a volume of 1000 mL in a volumetric flask. This is the primary standard for the procedure.

CARBON AND ORGANIC MATTER

2. Concentrated sulfuric acid-
3. Ferrous ammonium sulfate of ferrous ammonium sulfate concentrated sulfuric acid :
ume of 2 L in a volumetric daily because it undergoes
4. Indicator solution—Dissolv g of Na_2CO_3 in 100 mL of

Procedure

Weigh an amount of soil air dri greater than 8 mg of organic C (usual tube and add 5 mL of 0.167 *M* (1.0 *N*) trated H_2SO_4 . Place the tube in the di ly 30 min. Remove the digestion tub cool for 30 min at room temperature tube to a 125-mL Erlenmeyer flask a rous ammonium sulfate solution usir solution as the indicator. The color ch green and is very rapid. An illuminat observing the end point and the titr burette calibrated at 0.1-mL interval: teflon coated stirring bar.

Each set of soil samples shou blanks and two reagent blanks that a The unheated blanks are used to stan tion. The difference in titration valu used to correct all sample titration val by thermal decomposition during the

Computation of the organic C subtract sample titration values (*mL*, heated (boiled) blank (*mL_{bb}*), (ii) cor thermal decomposition of dichromate tion value for unheated and heated t unheated blank, multiplying the cor [*mL_{bb}* - *mL_{soil}*] value, and adding th [13]). The resulting value, labeled "A present in the soil, (iii) complete the [14]

$$A = (\text{mL}_{\text{bb}} - \text{mL}_{\text{soil}}) \frac{(\text{m}}{}$$

where *ub* is unboiled blank and *bb* is

$$\text{Organic C, \%} =$$

200 mL of water to the flask, and filter paper (e.g., Whatman 540), if titration cannot otherwise be clearly enanthroline indicator and titrate the end point is approached, the solution to a dark green. At this point, add the until the color changes sharply from against a white background). Make a but without soil, to standardize the ss soil if >75% of the dichromate is

following formula, using a correction found experimentally

$$\frac{(M_{\text{Fe}^{2+}})(0.003)(100)}{\text{wt. water-free soil, g}} \times f \quad [12]$$

Walkley-Black procedure has been (Table 34-3). Ferrous ammonium sulfate in conjunction with the Walkley-Black modification involving complete reduction and back-titration of excess Fe^{2+} with the unreacted $\text{Cr}_2\text{O}_7^{2-}$. Other oxidation-satisfactory results include barium anthranilic acid. The amounts of $\text{Cr}_2\text{O}_7^{2-}$ and anthranilic matter also may be estimated collectively with a ferrous ammonium sulfate solution shown to reduce sampling errors and for very large sample sizes (1 g) are used. It is noted that reduction in particle size from 10 to 20 μ of organic C in 12 soils.

sized for block digester.

block digester supplied by Technicon NY, or Tecator Inc., Herndon, VA, or

0.167 M (1.0 N)—dissolve 49.025 g of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in 100 mL of distilled water and dilute the solution to 1000 mL in a volumetric flask. This is the standard solution.

2. Concentrated sulfuric acid—specific gravity 1.84.
3. Ferrous ammonium sulfate solution 0.2 M (0.2 N)—Dissolve 156.8 g of ferrous ammonium sulfate $[\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}]$ in 100 mL of concentrated sulfuric acid and dilute the solution with water to a volume of 2 L in a volumetric flask. This solution must be standardized daily because it undergoes slow oxidation.
4. Indicator solution—Dissolve 0.1 g of *N*-phenylanthranilic acid and 0.1 g of Na_2CO_3 in 100 mL of distilled water.

Procedure

Weigh an amount of soil air dried and ground to <0.15 mm containing not greater than 8 mg of organic C (usually 100–500 mg) into a clean, dry digestion tube and add 5 mL of 0.167 M (1.0 N) $\text{K}_2\text{Cr}_2\text{O}_7$ solution and 7.5 mL of concentrated H_2SO_4 . Place the tube in the digestion block preheated to 150°C for exactly 30 min. Remove the digestion tube from the block and allow the samples to cool for 30 min at room temperature. Quantitatively transfer the contents of the tube to a 125-mL Erlenmeyer flask and titrate the sample with 0.2 M (0.2 N) ferrous ammonium sulfate solution using 0.2 mL of the *N*-phenylanthranilic acid solution as the indicator. The color change at the end point is from violet to bright green and is very rapid. An illuminated background is recommended for ease in observing the end point and the titration should be performed using a 25-mL burette calibrated at 0.1-mL intervals and a variable speed magnetic stirrer and teflon coated stirring bar.

Each set of soil samples should be analyzed with two unheated reagent blanks and two reagent blanks that are heated at the same time as the samples. The unheated blanks are used to standardize the ferrous ammonium sulfate solution. The difference in titration values between heated and unheated blanks is used to correct all sample titration values for the amount of dichromate consumed by thermal decomposition during the heating process.

Computation of the organic C content of soil is performed as follows: (i) subtract sample titration values (mL_{soil}) from the average titration value of the heated (boiled) blank (mL_{bb}), (ii) correct the resulting $[mL_{\text{bb}} - mL_{\text{soil}}]$ value for thermal decomposition of dichromate by dividing the difference in average titration value for unheated and heated blanks by the average titration value for the unheated blank, multiplying the correction factor (normally 0.04–0.08) by the $[mL_{\text{bb}} - mL_{\text{soil}}]$ value, and adding the product to the $[mL_{\text{bb}} - mL_{\text{soil}}]$ value (Eq. [13]). The resulting value, labeled "A" is proportional to the amount of organic C present in the soil, (iii) complete the calculation of organic C content using Eq. [14]

$$A = (mL_{\text{bb}} - mL_{\text{soil}}) \frac{(mL_{\text{ub}} - mL_{\text{bb}})}{mL_{\text{ub}}} + (mL_{\text{bb}} - mL_{\text{soil}}) \quad [13]$$

where *ub* is unboiled blank and *bb* is boiled blank.

$$\text{Organic C, \%} = \frac{(A)(M_{\text{Fe}^{2+}})(0.003)(100)}{\text{wt. water-free soil, g}} \quad [14]$$

CARBON AND ORGANIC MATTER

determine organic C in soils (Bren
inson, 1973; Nelson & Sommers, 1
methods are normally considered t
and other methods are calibrated a

A number of studies have been conducted with dry or wet combustion methods. Walkley and Black (1934) have shown that the Walkley-Black method overestimates organic C from soil, i.e., in some soils >95% of the organic C is converted to CO₂. Allison et al. (1960a) showed that for 15 soils the Walkley-Black method (using a correction factor of 1.1) gave combustion values. Kalembasa and Parton (1986) showed the recovery of organic C by the Walkley-Black method varied from 60 to 122% of wet combustion values. The Walkley-Black method was 10% higher than the Walkley-Black method with correction. More recent studies have found that the Walkley-Black method and Australia is much more susceptible to overestimation. The Walkley-Black procedure than was expected. The recovery of organic C varied from 88 to 97% of wet combustion values (Heanes, 1984; Lowther et al., 1990). The correction factor for unoxidized organic C is 1.1. For natural soil, but for a group of soils the organic C values determined by dry combustion are higher than when the appropriate correction factor is used. Furthermore, the simple method, in part, compensate for the lack of correction.

Dichromate methods that involve (e.g., Tyurin, 1931) have been used. Appropriate correction factors are available (e.g., & Weldon, 1941; Kalembasa & Jørgensen, 1983) are 1.15 and 1.08 for the Schollenberger and Tyurin methods, respectively. Vatta et al. (1989) found that no correction factor for the Schollenberger procedure was used.

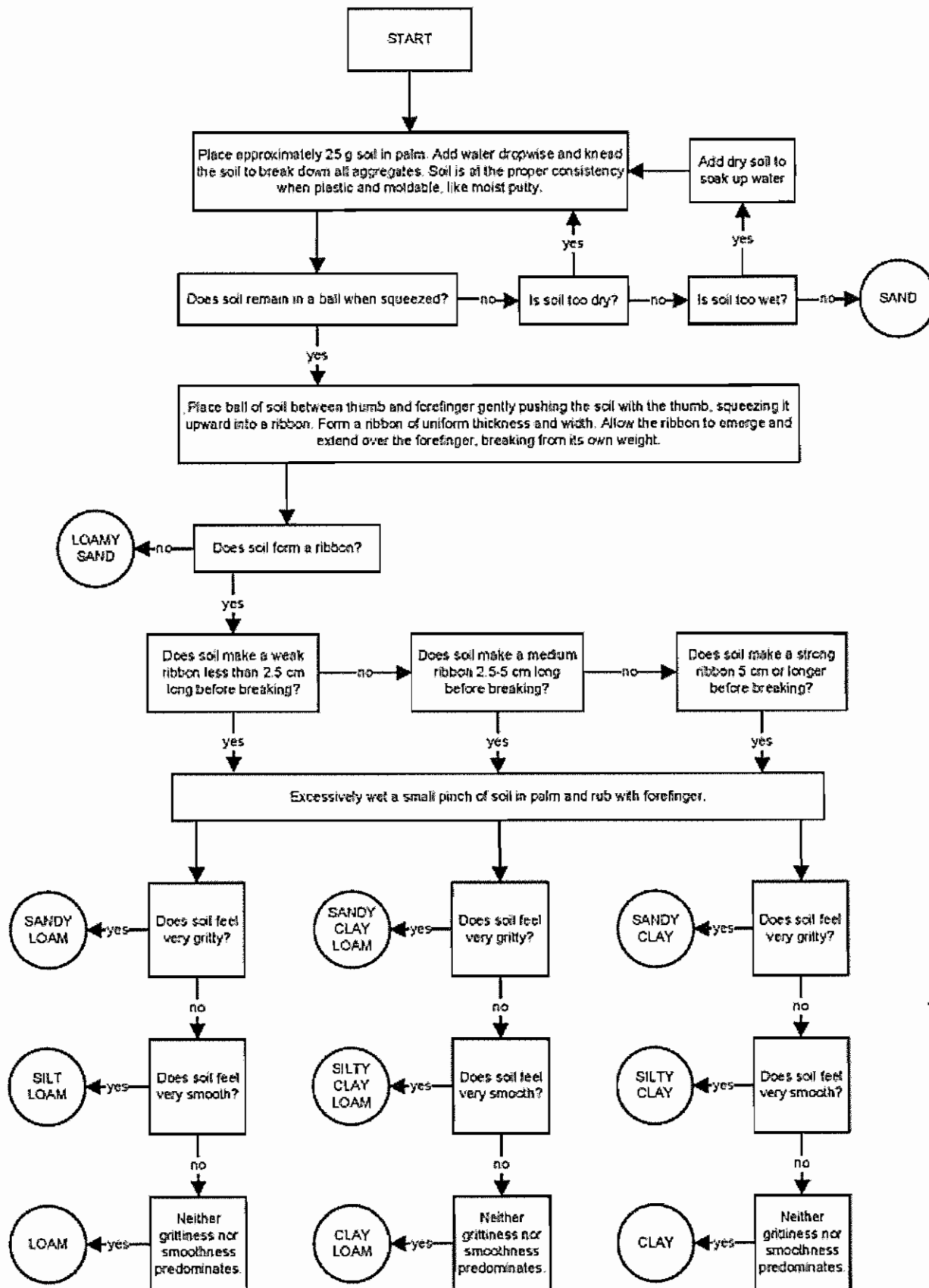
Modern dichromate oxidative heating, often under reflux, (e.g., Allison & Sommers, 1975; Heanes, 1975) gave C values equivalent to those obtained by the method of Bremner and Jenkinson (1960a) for values of 15 soils that varied from 0.1 to 1.5% C. Both methods yielded organic C recoveries of 95 and 98% respectively, of wet and dry combustion. The Mebius procedure reported that the organic C found in 10 soils by both methods have given excellent aver-

Most studies have shown that very good agreement is obtained when wet combustion, dry combustion, and Van Slyke-Folch (1940) methods are used to



Guide to Texture by Feel

Modified from S.J. Thien. 1979. *A flow diagram for teaching texture by feel analysis*. Journal of Agronomic Education. 8:54-55.
(Click [here](#) for a high-resolution version of the graphic.)



Texture class is one of the first things determined when a soil is examined. It is related to weathering and parent material. The differences in horizons may be due to the differences in texture of their respective parent materials.

Texture class can be determined fairly well in the field by feeling the sand particles and estimating silt and clay content by flexibility and stickiness. There is no field mechanical-analysis procedure that is as accurate as the fingers of an experienced

scientist, especially if standard samples are available. A person must be familiar with the composition of the local soils. This is because certain characteristics of soils can create incorrect results if the person does not take these characteristics into account.

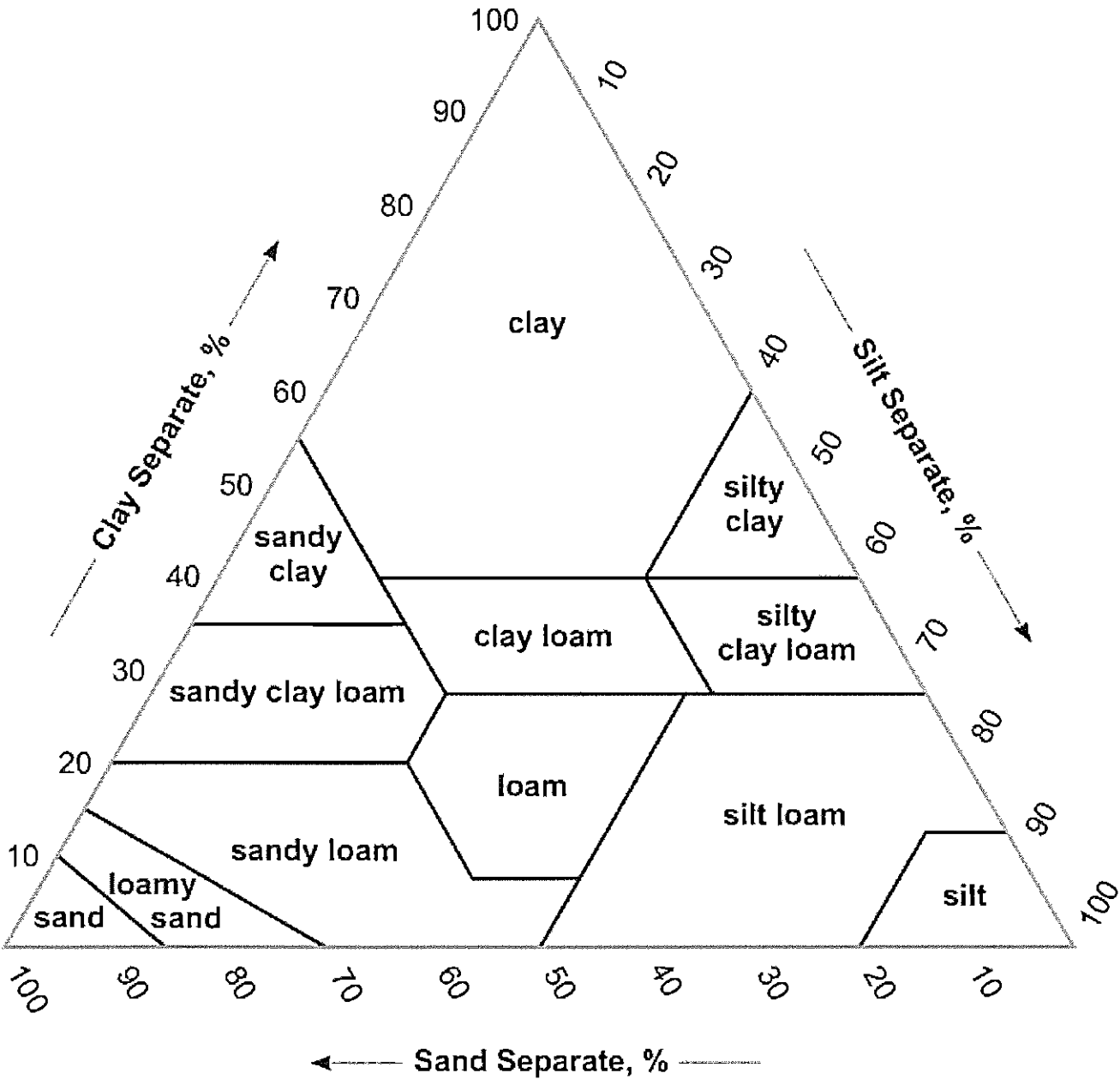
In some environments clay aggregates form that are so strongly cemented together that they feel like fine sand or silt. In humid climates iron oxide is the cement. In desert climates silica is the cement and in arid regions lime can be the cement. It takes prolonged rubbing to show that they are clays and not silt loams.

Some soils derived from granite contain grains that resemble mica but are softer. Rubbing breaks down these grains and reveals that they are clay. These grains resist dispersion and field and laboratory determinations may disagree.

Many soil conditions and components mentioned earlier cause inconsistencies between field texture estimates and standard laboratory data. These are, but not limited to, the presence of cements, large clay crystals, and mineral grains. If field and laboratory determinations are inconsistent, one or more of these conditions is suspected.

Soil Textural Triangle

Click [here](#) for a high-resolution version of the graphic.



METHOD 3060A

ALKALINE DIGESTION FOR HEXAVALENT CHROMIUM

1.0 SCOPE AND APPLICATION

1.1 Any reference in this method to "Method 3060" refers to this version of that method, and does not refer to previously published versions (e.g., in the Second Edition of this manual). When published as a new method to SW-846, a method's number does not include a letter suffix. Each time a method is revised and made a part of SW-846 update, it receives a suffix. However, a method reference found within the text of SW-846 methods always refers to the latest version of that method published in SW-846, even if the method number at that location does not include the appropriate letter suffix.

1.2 Method 3060 is an alkaline digestion procedure for extracting hexavalent chromium [Cr(VI)] from soluble, adsorbed, and precipitated forms of chromium compounds in soils, sludges, sediments, and similar waste materials. To quantify total Cr(VI) in a solid matrix, three criteria must be satisfied: (1) the extracting solution must solubilize all forms of Cr(VI), (2) the conditions of the extraction must not induce reduction of native Cr(VI) to Cr(III), and (3) the method must not cause oxidation of native Cr(III) contained in the sample to Cr(VI). Method 3060 meets these criteria for a wide spectrum of solid matrices. Under the alkaline conditions of the extraction, minimal reduction of Cr(VI) or oxidation of native Cr(III) occurs. The addition of Mg^{2+} in a phosphate buffer to the alkaline solution has been shown to suppress oxidation, if observed. The accuracy of the extraction procedure is assessed using spike recovery data for soluble and insoluble forms of Cr(VI) (e.g., $\text{K}_2\text{Cr}_2\text{O}_7$ and PbCrO_4), coupled with measurement of ancillary soil properties, indicative of the potential for the soil to maintain a Cr(VI) spike during digestion, such as oxidation reduction potential (ORP), pH, organic matter content, ferrous iron, and sulfides. Recovery of an insoluble Cr(VI) spike can be used to assess the first two criteria, and method-induced oxidation is usually not observed except in soils high in Mn and amended with soluble Cr(III) salts or freshly precipitated $\text{Cr}(\text{OH})_3$.

1.3 The quantification of Cr(VI) in Method 3060 digests should be performed using a suitable technique with appropriate accuracy and precision, for example Method 7196 (colorimetrically by UV-VIS spectrophotometry) or Method 7199 (colorimetrically by ion chromatography (IC)). Analytical techniques such as IC with inductively coupled plasma - mass spectrometric (ICP-MS) detection, high performance liquid chromatography (HPLC) with ICP-MS detection, capillary electrophoresis (CE) with ICP-MS detection, etc. may be utilized once performance effectiveness has been validated.

2.0 SUMMARY OF METHOD

2.1 This method uses an alkaline digestion to solubilize both water-insoluble (with the exception of partial solubility of barium chromate in some soil matrices, see Reference 10.9) and water soluble Cr(VI) compounds in solid waste samples. The pH of the digestate must be carefully adjusted during the digestion procedure. Failure to meet the pH specifications will necessitate redigestion of the samples.

2.2 The sample is digested using 0.28M Na_2CO_3 /0.5M NaOH solution and heating at 90-95°C for 60 minutes to dissolve the Cr(VI) and stabilize it against reduction to Cr(III).

2.3 The Cr(VI) reaction with diphenylcarbazide is the most common and reliable method for analysis of Cr(VI) solubilized in the alkaline digestate. The use of diphenylcarbazide has been well established in the colorimetric procedure (Method 7196), in rapid-test field kits, and in the ion chromatographic method for Cr(VI) (Method 7199). It is highly selective for Cr(VI) and few interferences are encountered when it is used on alkaline digestates.

2.4 For additional information on health and safety issues relating to chromium, refer to References 10.7 and 10.10.

3.0 INTERFERENCES

3.1 When analyzing a sample digest for total Cr(VI), it is appropriate to determine the reducing/oxidizing tendency of each sample matrix. This can be accomplished by characterization of each sample for additional analytical parameters, such as pH (Method 9045), ferrous iron (ASTM Method D3872-86), sulfides (Method 9030), and Oxidation Reduction Potential (ORP) (ASTM Method D 1498-93 - aqueous samples). Method 9045 (Section 7.2 of Method 9045) is referenced as the preparatory method for soil samples. The ORP and temperature probes are inserted directly into the soil slurry. The displayed ORP value is allowed to equilibrate and the resulting measurement is recorded. Other indirect indicators of reducing/oxidizing tendency include Total Organic Carbon (TOC), Chemical Oxygen Demand (COD), and Biological Oxygen Demand (BOD). Analysis of these additional parameters establishes the tendency of Cr(VI) to exist or not exist in the unspiked sample(s) and assists in the interpretation of QC data for matrix spike recoveries outside the conventionally accepted criteria for total metals.

3.2 Certain substances, not typically found in the alkaline digests of soils, may interfere in the analytical methods for Cr(VI) following alkaline extraction if the concentrations of these interfering substances are high and the Cr(VI) concentration is low. Refer to Methods 7196 and 7199 for a discussion of the specific agents that may interfere with Cr(VI) quantification. Analytical techniques that reduce bias caused by co-extracted matrix components may be applicable in correcting these biases after validation of their performance effectiveness.

3.3 For waste materials or soils containing soluble Cr(III) concentrations greater than four times the laboratory Cr(VI) reporting limit, Cr(VI) results obtained using this method may be biased high due to method-induced oxidation. The addition of Mg^{2+} in a phosphate buffer to the alkaline extraction solution has been shown to suppress this oxidation. If an analytical method for Cr(VI) is used that can correct for possible method induced oxidation/reduction, then the Mg^{2+} addition is optional. The presence of soluble Cr(III) can be approximated by extracting the sample with deionized water (ASTM methods D4646-87, D5233-92, or D3987-85) and analyzing the resultant leachate for both Cr(VI) and total Cr. The difference between the two values approximates soluble Cr(III).

4.0 APPARATUS AND MATERIALS

4.1 Digestion vessel: borosilicate glass or quartz with a volume of 250 mL.

4.2 Graduated Cylinder: 100-mL or equivalent.

4.3 Volumetric Flasks: Class A glassware, 1000-mL and 100-mL, with stoppers or equivalent.

- 4.4 Vacuum Filtration Apparatus.
- 4.5 Filter membranes (0.45 μm). Preferably cellulosic or polycarbonate membranes. When vacuum filtration is performed, operation should be performed with recognition of the filter membrane breakthrough pressure.
- 4.6 Heating Device - capable of maintaining the digestion solution at 90-95 $^{\circ}\text{C}$ with continuous auto stirring capability or equivalent.
- 4.7 Volumetric pipettes: Class A glassware, assorted sizes, as necessary.
- 4.8 Calibrated pH meter.
- 4.9 Calibrated balance.
- 4.10 Temperature measurement device (with NIST traceable calibration) capable of measuring up to 100 $^{\circ}\text{C}$ (e.g. thermometer, thermistor, IR sensor, etc.).
- 4.11 An automated continuous stirring device (e.g. magnetic stirrer, motorized stirring rod, etc.), one for each digestion being performed.

5.0 REAGENTS

5.1 Nitric acid: 5.0 M HNO_3 , analytical reagent grade or spectrograde quality. Store at 20-25 $^{\circ}\text{C}$ in the dark. Do not use concentrated HNO_3 to make up 5.0 M solution if it has a yellow tinge; this is indicative of photoreduction of NO_3^- to NO_2 , a reducing agent for Cr(VI).

5.2 Sodium carbonate: Na_2CO_3 , anhydrous, analytical reagent grade. Store at 20-25 $^{\circ}\text{C}$ in a tightly sealed container.

5.3 Sodium hydroxide: NaOH , analytical reagent grade. Store at 20-25 $^{\circ}\text{C}$ in a tightly sealed container.

5.4 Magnesium Chloride: MgCl_2 (anhydrous), analytical reagent grade. A mass of 400 mg MgCl_2 is approximately equivalent to 100 mg Mg^{2+} . Store at 20-25 $^{\circ}\text{C}$ in a tightly sealed container.

5.5 Phosphate Buffer:

5.5.1 K_2HPO_4 : analytical reagent grade.

5.5.2 KH_2PO_4 : analytical reagent grade.

5.5.3 0.5M K_2HPO_4 /0.5M KH_2PO_4 buffer at pH 7: Dissolve 87.09 K_2HPO_4 and 68.04 g KH_2PO_4 into 700 mL of reagent water. Transfer to a 1L volumetric flask and dilute to volume.

5.6 Lead Chromate: PbCrO_4 , analytical reagent grade. The insoluble matrix spike is prepared by adding 10-20 mg of PbCrO_4 to a separate sample aliquot. Store under dry conditions at 20-25°C in a tightly sealed container.

5.7 Digestion solution: Dissolve 20.0 ± 0.05 g NaOH and 30.0 ± 0.05 g Na_2CO_3 in reagent water in a one-liter volumetric flask and dilute to the mark. Store the solution in a tightly capped polyethylene bottle at 20-25°C and prepare fresh monthly. The pH of the digestion solution must be checked before using. The pH must be 11.5 or greater, if not, discard.

5.8 Potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$, spiking solution (1000 mg/L Cr(VI)): Dissolve 2.829 g of dried (105 °C) $\text{K}_2\text{Cr}_2\text{O}_7$ in reagent water in a one-liter volumetric flask and dilute to the mark. Alternatively, a 1000 mg/L Cr(VI) certified primary standard solution can be used (Fisher AA S standard or equivalent). Store at 20-25°C in a tightly sealed container for use up to six months.

5.8.1 Matrix spiking solution (100 mg/L Cr(VI)): Add 10.0 mL of the 1000 mg Cr(VI)/L made from $\text{K}_2\text{Cr}_2\text{O}_7$ spiking solution (Section 5.8) to a 100 mL volumetric flask and dilute to volume with reagent water. Mix well.

5.9 Reagent Water - Reagent water will be free of interferences. Refer to Chapter One for a definition of reagent water.

6.0. SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 Samples must have been collected using a sampling plan that addresses the considerations discussed in Chapter Nine of this manual.

6.2 Samples should be collected using devices and placed in containers that do not contain stainless steel (e.g., plastic or glass).

6.3 Samples should be stored field-moist at 4 ± 2 °C until analysis.

6.4 Hexavalent chromium has been shown to be quantitatively stable in field-moist soil samples for 30 days from sample collection. In addition, Cr(VI) has also been shown to be stable in the alkaline digestate for up to 168 hours after extraction from soil.

6.5 Hexavalent chromium solutions or waste material that are generated should be disposed of properly. One approach is to treat all Cr(VI) waste materials with ascorbic acid or other reducing agent to reduce the Cr(VI) to Cr(III). For additional information on health and safety issues relating to chromium, the user is referred to References 10.7 and 10.10.

7.0 PROCEDURE

7.1 Adjust the temperature setting of each heating device used in the alkaline digestion by preparing and monitoring a temperature blank [a 250 mL vessel filled with 50 mLs digestion solution (Section 5.7)]. Maintain a digestion solution temperature of 90-95°C as measured with a NIST-traceable thermometer or equivalent.

7.2 Place 2.5 ± 0.10 g of the field-moist sample into a clean and labeled 250 mL digestion vessel. The sample should have been mixed thoroughly before the aliquot is removed.

For the specific sample aliquot that is being spiked (Section 8.5), the spike material should be added directly to the sample aliquot at this point. (Percent solids determination, U.S. EPA CLP SOW for Organic Analysis, OLM03.1, 8/94 Rev.) should be performed on a separate aliquot in order to calculate the final result on a dry-weight basis).

7.3 Add 50 mL \pm 1 mL of digestion solution (Section 5.7) to each sample using a graduated cylinder, and also add approximately 400 mg of MgCl_2 (Section 5.4) and 0.5 mL of 1.0M phosphate buffer (Section 5.5.3). For analytical techniques that can correct for oxidation/reduction of Cr, the addition of Mg^{2+} is optional. Cover all samples with watch glasses.

7.4 Stir the samples continuously (unheated) for at least five minutes using an appropriate stirring device.

7.5 Heat the samples to 90-95 °C, then maintain the samples at 90-95 °C for at least 60 minutes with continuous stirring.

7.6 Gradually cool, with continued agitation, each solution to room temperature. Transfer the contents quantitatively to the filtration apparatus; rinsing the digestion vessel with 3 successive portions of reagent water. Transfer the rinsates to the filtration apparatus. Filter through a 0.45 μm membrane filter. Rinse the inside of the filter flask and filter pad with reagent water and transfer the filtrate and the rinses to a clean 250-mL vessel.

NOTE: The remaining solids and filter paper resulting from filtration of the matrix spike in Section 7.6 should be saved for possible use in assessing low Cr(VI) matrix spike recoveries. See Section 8.5.2. for additional details. Store the filtered solid at 4 ± 2 °C.

7.7 Place an appropriate stirring device into the sample digest beaker, place the vessel on a stirrer, and, with constant stirring, slowly add 5.0 M nitric acid solution to the beaker dropwise. Adjust the pH of the solution to 7.5 ± 0.5 if the sample is to be analyzed using Method 7196 (adjust the pH accordingly if an alternate analytical method is to be used; i.e. 9.0 ± 0.5 if Method 7199 is to be used) and monitor the pH with a pH meter. If the pH of the digest should deviate from the desired range, discard the solution and redigest. If overshooting the desired pH range occurs repeatedly, prepare diluted nitric acid solution and repeat digestion procedure. If a flocculent precipitate should form, the sample should be filtered through a 0.45 μm membrane filter. If the filter becomes clogged using the 0.45 μm filter paper, a larger size filter paper (Whatman GFB or GFF) may be used to prefilter the samples.

CAUTION: CO_2 will be evolved. This step should be performed in a fume hood.

7.8 Remove the stirring device and rinse, collecting the rinsate in the beaker. Transfer quantitatively the contents of the vessel to a 100 mL volumetric flask and adjust the sample volume to 100 mL (to the mark for the volumetric flask) with reagent water. Mix well.

7.9 The sample digestates are now ready to be analyzed. Determine the Cr(VI) concentration in mg/kg by a suitable technique with appropriate accuracy and precision, for example Method 7196 (colorimetrically by UV-VIS spectrophotometry) or Method 7199 (colorimetrically by ion chromatography (IC)). Another analytical technique such as IC with inductively coupled plasma - mass spectrometric (ICP-MS) detection, high performance liquid chromatography (HPLC) with ICP-

MS detection, capillary electrophoresis (CE) with ICP-MS detection, etc. may be utilized once performance effectiveness has been validated.

7.10 CALCULATIONS

7.10.1 Sample Concentration

$$\text{Concentration} = \frac{A \times D \times E}{B \times C}$$

where: A = Concentration observed in the digest (µg/mL)
B = Initial moist sample weight (g)
C = % Solids/100
D = Dilution Factor
E = Final digest volume (mL)

7.10.2 Relative Percent Difference

$$\text{RPD} = \frac{(S - D)}{[(S + D)/2]}$$

where: S = Initial sample result
D = Duplicate sample result

7.10.3 Spike Recovery

$$\text{Percent Recovery} = \frac{(\text{SSR} - \text{SR})}{\text{SA}} \times 100$$

where: SSR = Spike sample result
SR = Sample (unspiked) result
SA = Spike added

8.0 QUALITY CONTROL

8.1 The following Quality Control (QC) analyses must be performed per digestion batch as discussed in Chapter One.

8.2 A preparation blank must be prepared and analyzed with each digestion batch, as discussed in Chapter One and detected Cr(VI) concentrations must be less than the method detection limit or one-tenth the regulatory limit or action level, whichever is greater or the entire batch must be redigested.

8.3 Laboratory Control Sample (LCS): As an additional determination of method performance, utilize the matrix spike solution prepared in Section 5.8.1 or the solid matrix spiking agent PbCrO_4 (Section 5.6) to spike into 50 mL of digestion solution (Section 5.7). Alternatively, the use of a certified solid reference material (if available) is recommended. Recovery must be within the certified acceptance range or a recovery range of 80% to 120% or the sample batch must be reanalyzed.

8.4 A separately prepared duplicate soil sample must be analyzed at a frequency of one per batch as discussed in Chapter One. Duplicate samples must have a Relative Percent Difference (RPD) of $\leq 20\%$, if both the original and the duplicate are \geq four times the laboratory reporting limit. A control limit of \pm the laboratory reporting limit is used when either the original or the duplicate sample is $<$ four times the laboratory reporting limit.

8.5 Both soluble and insoluble pre-digestion matrix spikes must be analyzed at a frequency of one each per batch of ≤ 20 field samples. The soluble matrix spike sample is spiked with 1.0 mL of the spiking solution prepared in Section 5.8.1 (equivalent to 40 mg Cr(VI)/Kg) or at twice the sample concentration, whichever is greater. The insoluble matrix spike is prepared by adding 10-20 mg of PbCrO_4 (Section 5.6) to a separate sample aliquot. It is used to evaluate the dissolution during the digestion process. Both matrix spikes are then carried through the digestion process described in Section 7.0. More frequent matrix spikes must be analyzed if the soil characteristics within the analytical batch appear to have significant variability based on visual observation. An acceptance range for matrix spike recoveries is 75-125%. If the matrix spike recoveries are not within these recovery limits, the entire batch must be rehomogenized/redigested/reanalyzed. If upon reanalysis, the matrix spike is not within the recovery limits, but the LCS is within criteria specified in Section 8.3, information such as that specified on Figures 1 and 2 and in Section 3.1 should be carefully evaluated. The Cr(VI) data may be valid for use despite the perceived "QC failure." The information shown on Figure 1 and discussed below is provided to interpret ancillary parameter data in conjunction with data on spike recoveries.

8.5.1 First measure the pH (Method 9045) and Oxidation Reduction Potential (ORP) (ASTM Method D 1498-93 - aqueous samples, Method 9045 preparatory for soil samples), in the field if possible. If not possible, the measurements are to be made in the laboratory prior to the determination of the spike recovery data. When and where the measurements are taken must be noted by the analyst. Adjust the ORP measurement based on reference electrode correction factor to yield Eh values. The pH and Eh values should be plotted on Figure 2 in order to give an initial indication of the sample's reducing/oxidizing nature. Upon completion of the analysis of the analytical batch, the LCS should be evaluated. If the LCS is not within 80 - 120% recovery or the certified acceptance range, then the entire analytical batch (plus the QC samples) should be redigested and reanalyzed. If the LCS was within acceptance criteria and the pre-digestion matrix spike recoveries for Cr(VI) were less than the acceptance range minimum (75%), this indicates that the soil samples reduced Cr(VI) (e.g., anoxic sediments), and no measurable native Cr(VI) existed in the unspiked sample (assuming the criteria in Section 8.3 are met). Such a result indicates that the combined and interacting influences of ORP, pH and reducing agents (e.g., organic acids, Fe^{2+} and sulfides) caused reduction of Cr(VI) spikes. Characterize each matrix spike sample for additional analytical parameters, such as ferrous iron (ASTM Method D3872-86), and sulfides (Method 9030). Laboratory measurements of pH and ORP should also be performed to confirm the field measurements. Other indirect indicators of reducing/oxidizing tendency include Total Organic Carbon (TOC), Chemical Oxygen Demand (COD), and Biological Oxygen Demand (BOD). Analysis of these additional parameters assists in evaluating the tendency of Cr(VI)

to exist or not exist in the unspiked sample(s) and assists in the interpretation of QC data for matrix spike recoveries outside conventionally accepted criteria for total metals.

A value of Eh-pH below the bold diagonal line on Fig. 2 indicates a reducing soil for Cr(VI). The downward slope to the right indicates that the Eh value, at which Cr(VI) is expected to be reduced, decreases with increasing pH. The solubility and quantity of organic constituents influence reduction of Cr(VI). The presence of H_2S or other strong odors indicates a reducing environment for Cr(VI). In general, acidic conditions accelerate the reduction of Cr(VI) in soils, and alkaline conditions tend to stabilize Cr(VI) against reduction. If pre-digestion matrix spike recovery is not within the recovery limits, the reductive nature of the sample must be documented. This is done by plotting the Eh and pH data on the Eh-pH diagram (Fig. 2) to see if spike recovery is or is not expected in the soil. If the data point falls below the Cr(VI)-Cr(III) line on the diagram, then the data is not qualified or rejected. The sample is reducing for Cr(VI). If the data point falls above the line, then the sample is capable of supporting Cr(VI). In this case, technical error may be responsible for the poor spike recovery, and the extraction should be repeated, along with the Eh and pH measurements. If re-extraction results in a poor spike recovery again, then the data is not qualified. At this point, review of other soil characteristics, such as levels of pH, Eh, TOC, sulfides, Fe(II), is appropriate to understand why poor spike recovery occurred. This extra review of these soil properties is only necessary if the unspiked sample contains detectable Cr(VI).

8.5.2 If a low or zero percent pre-digestion matrix spike recovery is obtained, an alternate approach can be used to determine the potential contribution of the sample matrix to Cr(VI) reduction. This approach consists of performing a mass balance, whereby total chromium is analyzed (Method 3052) for two samples: (1) a separate unspiked aliquot of the sample previously used for spiking, and (2) the digested solids remaining after the alkaline digestion and filtration of the matrix spike (i.e., the filtered solids from the matrix spike in Section 7.6).

The difference between the total chromium measurements should be approximately equal to the amount of the spike added to the matrix spike. If the LCS (Section 8.3) meets the acceptance criteria and the Cr(VI) spike is accounted for in the filtered solids as total chromium, it is likely that the reduction of the Cr(VI) to insoluble Cr(III) resulted from the reducing matrix of the original sample subjected to Cr(VI) spiking.

8.6 A post-digestion Cr(VI) matrix spike must be analyzed per batch as discussed in Chapter One. The post-digestion matrix spike concentration should be equivalent to 40 mg/kg or twice the sample concentration observed in the unspiked aliquot of the test sample, whichever is greater.

8.6.1 Dilute the sample aliquot to a minimum extent, if necessary, so that the absorbance reading for both the unspiked sample aliquot and spiked aliquot are within the initial calibration curve.

8.6.2 A guideline for the post-digestion matrix spike recovery is 85-115%. If not achieved, consider the corrective actions/guidance on data use specified in Section 8.5 or the Method of Standard Additions (MSA) as specified in Section 8.0 of Method 7000. If the MSA technique is applied post digestion and no spike is observed from the MSA, these results indicate that the matrix is incompatible with Cr(VI) and no further effort on the part of

the laboratory is required. These digestates may contain soluble reducing agents for Cr(VI), such as fulvic acids.

9.0 METHOD PERFORMANCE

9.1 A commercial laboratory analyzed soil/sediment samples containing Cr(VI) with the results found in Table 1.

10.0 REFERENCES

10.1 United States Environmental Protection Agency, 1982. Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. SW-846, Second Edition. Office of Solid Waste and Emergency Response, Washington, D.C.

10.2 New Jersey Department of Environmental Protection and Energy (NJDEPE). NJDEPE Modified Methods 3060/7196. 1992.

10.3 Vitale, R., G. Mussoline, J. Petura, B. James, 1993. A Method Evaluation Study of an Alkaline Digestion (Modified Method 3060) Followed by Colorimetric Determination (Method 7196) for the Analysis for Hexavalent Chromium in Solid Matrices. Environmental Standards, Inc. Valley Forge, PA 19482.

10.4 Zatka, V.J., 1985. Speciation of Hexavalent Chromium in Welding Fumes Interference by Air Oxidation of Chromium. J. Ray Gordon Research Laboratory, INCO Limited, Sheridan Park, Mississauga, Ontario L5K 1Z9, Am. Ind. Hyg. Assoc. J., 46(6) : 327-331.

10.5 ASTM (American Society for Testing and Materials), 1981. Standard Practice for Oxidation Reduction Potential of Water. ASTM Designation: D1498-93.

10.6 Vitale, R.J., Mussoline, G.R., Petura, J.C. and James, B.R. 1994. Hexavalent Chromium Extraction from Soils: Evaluation of an Alkaline Digestion Method. J. Environ. Qual. 23:1249-1256.

10.7 U.S. Department of Health and Human Services - Agency for Toxic Substances and Disease Registry. Toxicological Profile for Chromium. April, 1993.

10.8 Vitale, R.J., Mussoline, G.R., Petura, J.C. and James, B.R. 1995. Hexavalent Chromium Quantification in Soils: An Effective and Reliable Procedure. Am. Env. Lab., April Ed.

10.9 James, B.R., Petura, J.C., Vitale, R.J., and Mussoline, G.R. 1995. Hexavalent Chromium Extraction from Soils: A Comparison of Five Methods. Environ. Sci. Technol. 29:2377-2381.

10.10 U.S. Environmental Protection Agency. 1993. IRIS: A continuously updated electronic database maintained by the U.S. Environmental Protection Agency. National Library of Medicine, Bethesda, MD.

10.11 ASTM (American Society for Testing and Materials), 1981. Standard Test Method for Ferrous Iron in Iron Oxides. ASTM Designation:D3872-86.

10.12 ASTM (American Society for Testing and Materials), 1981. Standard Test Method for 24-h Batch-Type Measurement of Contaminant Sorption by Soil and Sediments. ASTM Designation:D4646-87.

10.13 ASTM (American Society for Testing and Materials), 1981. Standard Test Method for Single Batch Extraction Method for Waters. ASTM Designation:D5233-92.

10.14 ASTM (American Society for Testing and Materials), 1981. Standard Test Method for Shake Extraction of Solid Waste with Water. ASTM Designation:D3987-85.

10.15 U.S. EPA Contract Laboratory Program, Statement of Work for Organic Analysis , Multimedia Multiconcentration Document, OLM03.1, 8/94 Rev.

TABLE 1
SINGLE LABORATORY METHOD EVALUATION DATA

<u>Sample Type</u>	<u>Eh</u> <u>(mV)_b</u>	<u>pH_d</u>	<u>S²⁻</u> <u>(ppm)^c</u>	<u>Mean Native</u> <u>Cr(VI) Conc.</u> <u>(mg/kg)</u>	<u>Mean Cr(VI)</u> <u>Spike Conc.</u> <u>(mg/kg)</u>	<u>Matrix Spike</u> <u>Recovery</u> <u>Range, %</u>
COPR ^a /Soil Blends	550	7.4	<10.0	4.1	42.0	89.8-116
Loam	620	6.4	<10.0	ND	62.5	65.0-70.3
Clay	840	3.0	<10.0	ND	63.1	37.8-71.1
COPR ^a	460	7.4	<10.0	759	813	85.5-94.8
Anoxic Sediment	-189	7.2	25.0	ND	381	0
Quartz Sand	710	5.3	<10.0	ND	9.8	75.5-86.3

Source: Reference 10.3

Notes:

- ND - Not detected
- a - COPR - chromite ore processing residue
- b - Corrected for the reference electrode, laboratory field moist measurement
- c - Field measurement
- d - Laboratory field moist measurement

FIGURE 1
QUALITY CONTROL FLOW CHART

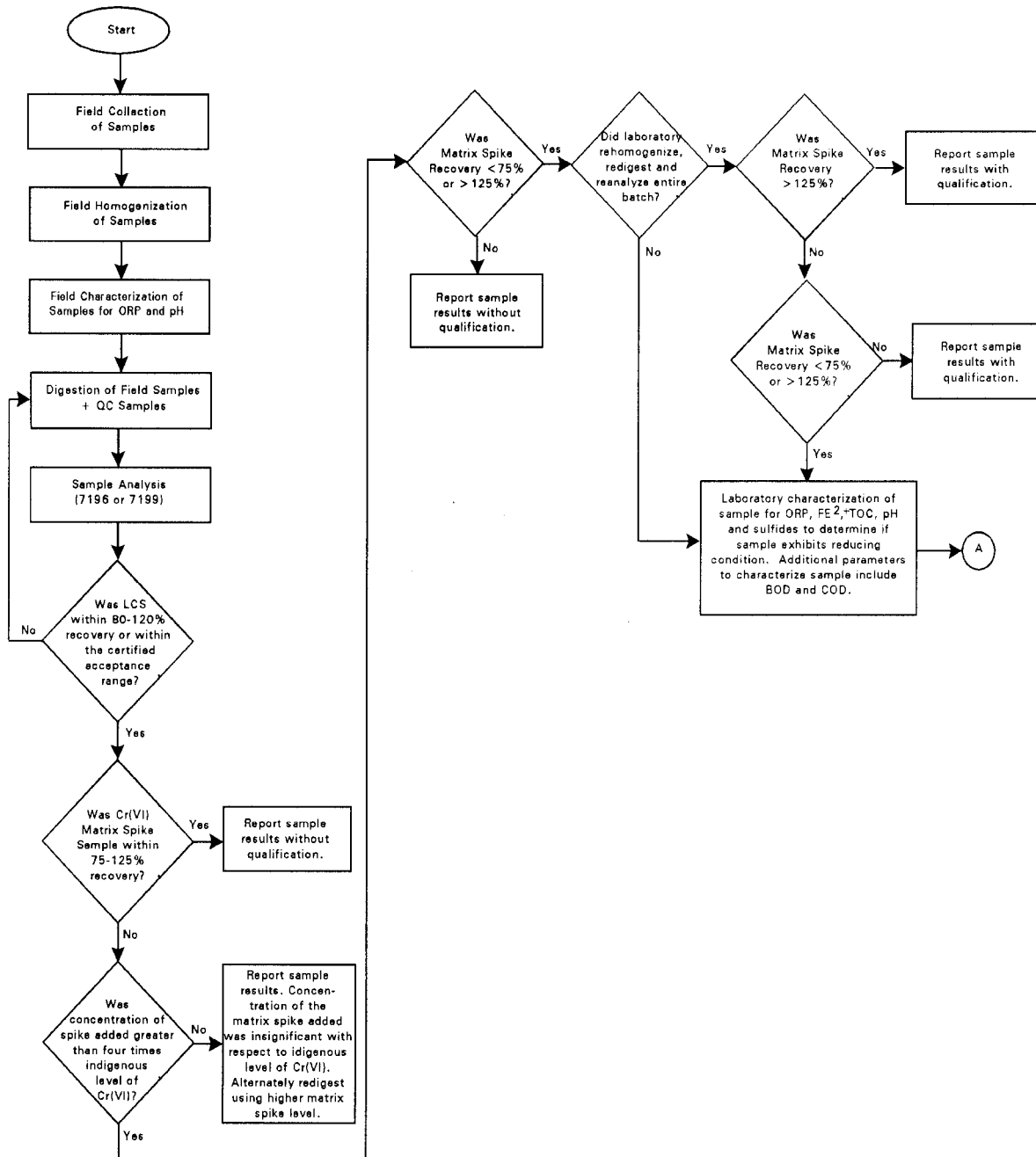


FIGURE 1
QUALITY CONTROL FLOW CHART (Continued)

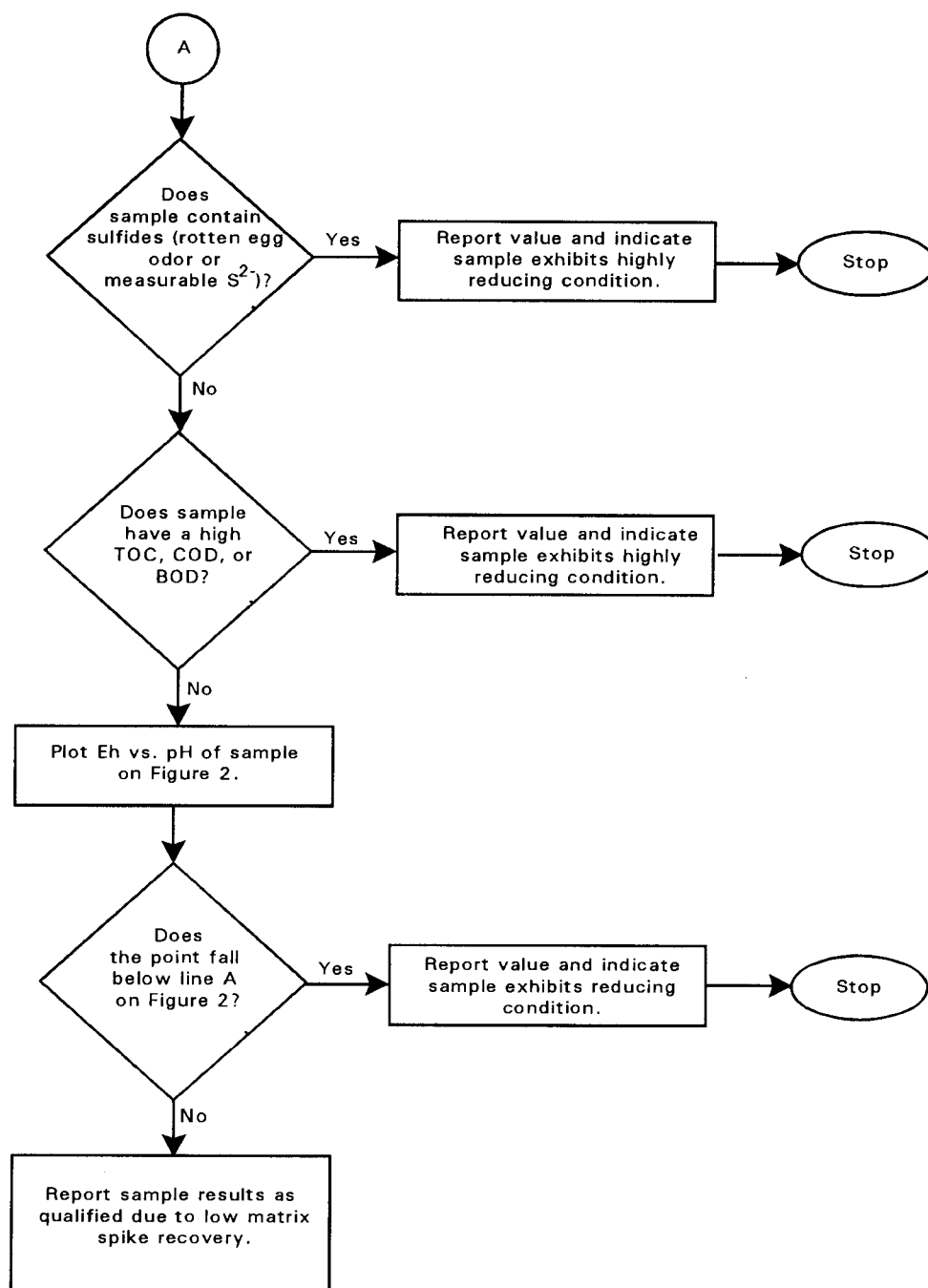
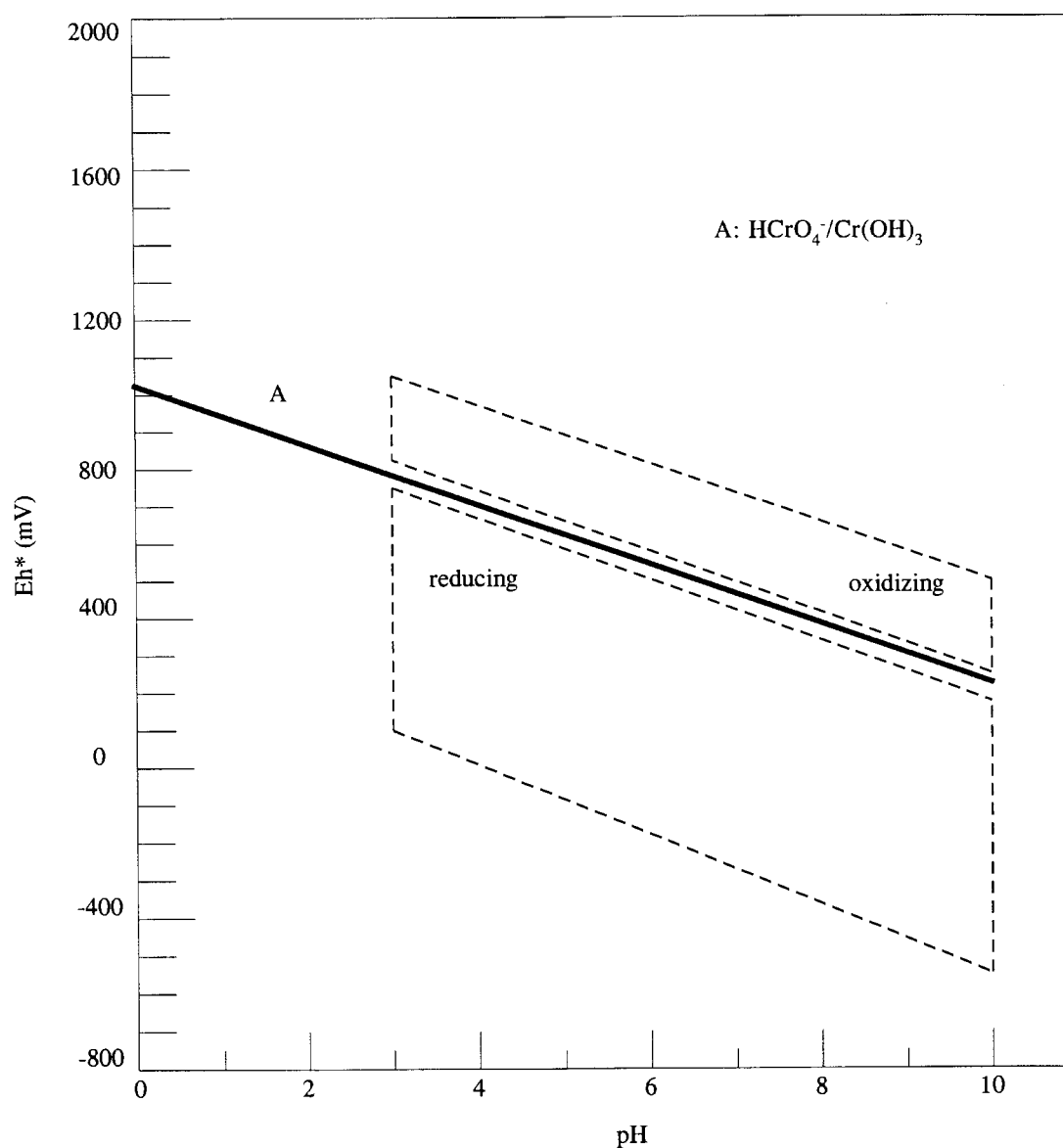


FIGURE 2
Eh/pH PHASE DIAGRAM

The dashed lines define Eh-pH boundaries commonly encountered in soils and sediments.



* Note the Eh values plotted on this diagram are corrected for the reference electrode voltage: 244 mV units must be added to the measured value when a separate calomel electrode is used, or 199 mV units must be added if a combination platinum electrode is used.

METHOD 3060A

ALKALINE DIGESTION FOR HEXAVALENT CHROMIUM

